The Welding Engineer

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Founded by L. B. Mackenzie, 1916

JULY, 1930 VOL. 15, NO. 7

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Constructive Dissatisfaction

COMPETITION, changing trends, business depressions and the like are not always the influential factors which cause manufacturers to modify and improve their products. Many a business feels these influences and yet does nothing about them except to use them as excuses for not making progress. The attitude of the modern progressive business executive is one of constructive dissatisfaction. He sees the shortcomings of his own product and of the products of his competitors. He studies his product in service and is not satisfied until improvement is made. At that time comes the task of transmitting his dissatisfaction to the hundreds or thousands of people who may profit by the improvement. They have to be informed that things which could not be done last year, or last month, can be done today because someone has not been satisfied to leave a problem unsolved and has produced the machine or the material which accomplishes this impossible task. Through advertising the public is made dissatisfied with old ways and old materials when better ways and better materials have been developed. The reading public has come to regard some types of advertising with disfavor but it will probably never cease to respond to the printed message which reflects a study of its problems and an earnest effort to furnish a better product.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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Compressed Industrial Gases
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Electric Arc Cutting & Welding Co.
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Bastian-Blessing Co.
Compressed Industrial Gases
Central Steel & Wire Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.

EVERYBODY'S BUSINESS

BY FLOYD W. PARSONS

Noise, Nerves and Business

IT is estimated that the annual cost of unnecessary noise is greater than the yearly losses to the nation from fire. What are we going to do about this uncontrolled din that is running up business costs and injuring human health?

City people cannot escape from the bedlam of sound that surrounds them. They cannot get away from riveting machines, fire-engine sirens, ambulance bells, police patrols, automobile horns and engines, rickety street cars, radios and the roar of machinery of one kind or another. It is for this reason that the control of noise has become one of our major problems.

For years we put up with the devils of din for no better reason than that a remedy for the nuisance appeared impossible. But recently the fight against needless noise was taken out of the hands of theorists and placed under the direction of technical minds who proceeded at once to carry out programs of research that quickly dispelled the idea that racket and prosperity are synonymous. It was pointed out by these hard-headed individuals that noise is no less a waste of industrial energy than smoke. It was shown that what we once called the "hum of industry" has now become a shriek—a malignant plague that is taking its toll of human life.

Results of Scientific Studies of Noise

Reform movements never amount to much until they get away from hasty assumptions founded on guessing and become established on the proved results of careful tests. Such studies now indicate that noise distracts attention, uses up human energy, deprives the individual of sleep, puts nerves on edge, impairs hearing, and spoils good dispositions.

Uncontrolled din now tortures thinkers, reduces the value of property along traffic routes and shortens the lives of thousands of sufferers. Anyone today passing a hospital or nursing home situated on a busy thoroughfare may well feel a sense of pity for the sick people within, whose very lives may be dependent upon the recuperative powers of undisturbed sleep.

A bedlam of sound often necessitates a concentration of attention so great that nervous fatigue is materially increased. The final outcome of this type of recurring shock is often a form of neurasthenia. We may question the assertion that noise is one of the chief causes of increasing insanity. We may also doubt the statement that needless din is responsible for as many "breakdowns" in our large cities as is overwork. But convincing proof is at hand to show that sudden and intermittent noises continued over a long period of time strike such a great number of blows on the auditory nerve that the delicate mechanism of the ear is eventually injured, if not destroyed. The human ear as now constructed is unable to attain immunity to sudden sounds.

Detrimental Effect on Morals

An environment of unceasing din is hard on ideals, and develops a desire for impossible romance that will provide release from raucous hurry and eight hours of aggravating realities. In the cases of people who cannot get away at night from the pounding of flat wheels, the grinding of motors, and the confusion of sounds from loudspeakers, street venders, clanging bells and blowing whistles, it often means the development of the habit of taking sleep-inducing drugs —a danger even more serious than bootleg liquor.

The Health Commissioner of New York says that when we hear a loud noise, especially one that is intermittent, like the screeching of automobile brakes, our heart action becomes irregular, our muscles grow tense and we involuntarily undergo a fear-reaction. All of this keys us up at a great cost to nerves and patience.

A noisy environment means the use of more energy in talking. Conversing on a railroad train or in the subway requires an expenditure of more than 10 times as much energy as in a quiet room. Telephone engineers say that the current used in the ordinary telephone is 100 times stronger than it would have to be were it operated under conditions of silence.

The Effect on Health

No one can properly estimate the cost to health and industry of the noises produced by riveting, automobile backfires, creaking elevators, clanging doors, ball cocks in water tanks, knocking steam radiators, dishwashing, alarm clocks, California jazz at three a. m., garbage collecting, and milk and ice deliveries at dawn.

Even though a person may not be awakened by a specific noise, the doctors tell us that every sound that is registered in the brain affects the body. A sleeper disturbed, but not awakened by noise, undergoes practically the same reaction to the sound he would have if he had been awakened. Night din often generates angry emotions which bring fatigue to the body. Sleep is no less a human necessity than food.

Typists working in a noisy room exert far more pressure on the keys. One study showed that by reducing the office noises 15 per cent, the production of typists was increased five per cent. Working under the handicap of noise they burned up 25 per cent more energy than when they labored in quiet surroundings.

The ear is one of the most complex of all human organs. Through it the nervous system is easily affected and fatigued. Strange as it may appear, the ear is the only organ of sense that has no legal protection. The law forbids offensive odors; insists upon cleanliness of all articles the public touches; demands that foodstuffs be pure and unadulterated; and endeavors to protect vision from signs and placards that are disgusting or obscene. But the ear, which is the shortest avenue to brain, is forced to stand the shock of an unending succession of sudden and intermittent sounds.

"Peace Shell-Shock"

Our present industrial era has been vulgarized by an absence of quietude and repose. Each advance in mechanical facilities has been accompanied by an advance in noise. This has brought our city people a new kind of disease that might be termed peace shell-shock. It breeds restlessness, urges activity, fosters patronage of the theater and amusement resorts, and even serves as a tonic to ambition. The individual living in a bedlam of noise becomes conscious that other men are rushing toward success and this gives him the desire to join in the mad dash to something that lies somewhere.

But this abnormal effort to increase accomplishment is made at too heavy a cost. In one recent experiment with rats, it was shown that a group kept in a quiet country house ate the least and yet became the prize group physically. The so-called city rats subjected to a continuous bedlam of synthetic sounds ate the most, but failed properly to digest their food. Living in a noisy environment they were continually on edge, which apparently brought an exaggerated energy-consuming response. More amazing was the fact that the litters of the city rats were smaller in number and a third of each litter were born dead.

With such an assemblage of evidence proving the evils of

(Concluded on page 56)

SAFETY REGULATORS

BY

VICTOR

TRADE MARK

UNSURPASSED IN PERFORMANCE

Reliable and safe.

For working pressures as low as 1/4 of an ounce—

Or as high as 500 lbs.

No fluctuation.

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Victor Welding Equipment Co.

844 Folsom Street **San Francisco**

EDITORIAL

What Makes a Good Welder?

DURING the summer vacation season, welding-school instructors are giving considerable thought to the possibility of improving their instruction programs for the coming school year. Welding instruction is needed for such a variety of purposes that so far no two welding courses have been discovered which are exactly alike. This condition is naturally due in large measure to the fact that those who have prepared welding courses have different opinions regarding the best way of training operators. In spite of these differences and in spite of the different requirements, there is a noticeable tendency in schools which teach welding to organize their courses so that graduates will be more useful to their employers; but while the instructor is trying his best to find the right answer to the question as to what makes a good welder, the prospective student probably keeps his mind mostly on the question concerning what jobs pays the most money. So, when schools get under way, we find many students more anxious to learn how to weld a certain type of job than how to become a thoroughly proficient welder. Probably one of the most difficult jobs of the school director is that of persuading the student to concentrate on what the instructor has to give him instead of letting his mind wander to certain operations which he believes will offer the best opportunities for big pay. The welding instructor must look forward to this problem and be prepared to convince each student how necessary it is to use his school time for obtaining the greatest possible knowledge of the real fundamentals of welding in order to earn the classification of a first-class welder, regardless of what type of welding he looks forward to as his future job.

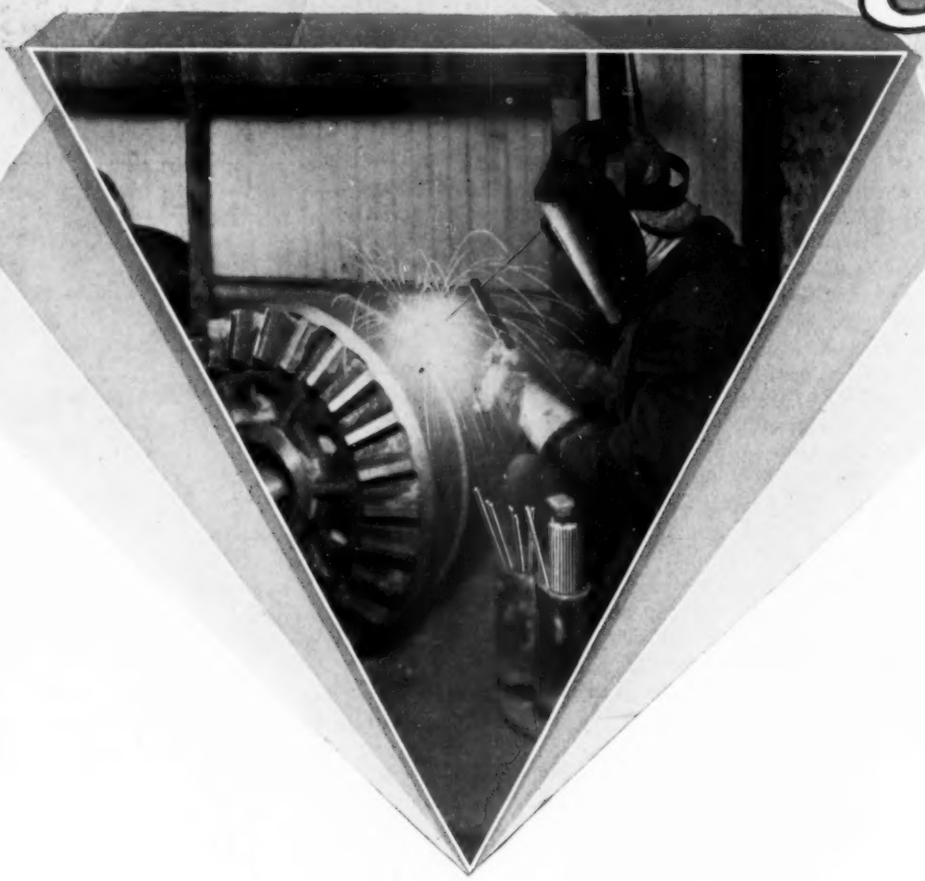
The Setting for the Metal Congress

DURING the summer months, men in industry will be kept informed through the pages of the business press of the plans which are being made for National Metal Week, which this year will be held in Chicago during the week of September 22nd. Men living at far-away points who have obtained impressions of the great midwestern industrial city chiefly from the tremendously spectacular newspaper accounts of Chicago's current adventures with the crime situation may wonder about the suitability of Chicago as a convention city. One answer to it is that during the next twelve months Chicago expects to welcome no less than half a million visitors in connection with the numerous conventions of national associations which are scheduled to be held in that city. In other words, men of affairs realize the great advantages of this great central meeting place. Nor does Chicago fear for the safety, or the comfort, or the peace of mind of these hundreds of thousands who will attend their conventions—many of them possibly for the first time. For the towering buildings of Chicago's business section are not the outgrowth of crime and corruption; they have grown up from the thousands of industrial plants spread out over an area many miles beyond the vision of one standing at the top of the tallest building in the city. It is a fact that a convention or exposition held in Chicago is always expected to be a great convention or a great exposition, and the expectation is realized with great regularity. Convention visitors are always enthusiastic in their appreciation of the hospitality behind which they know is a civic pride which is remarkably free from idle boastfulness. The public spirited citizen of another city can read in the constantly changing skyline visible from the great boulevards directly east of the business section an expression of unconditional faith in the city's future growth and prosperity. He can see in the evidences of municipal improvements and of welfare work, and in the true story of the city's courageous handling of an intolerable tax situation, definite indications of an almost unbelievable amount of energy being devoted to things which are altogether worthwhile. There is so much that is interesting, and even inspiring, that it is not until he finds himself homeward bound that the visitor realizes that some of the things with which he was most familiar and which he expected to see at close range practically do not exist. It is well, therefore, to keep in mind that National Metal Week is being held in the heart of a magnificent industrial area and in one of the most thriving sections of the country at the present time—a great steel producing and steel fabricating center and a great transportation center. These are only very general comments on the importance of the event; but altogether, they make up a collection of good and sufficient reasons for setting aside the week of September 22nd as a desirable time to visit Chicago.

An Old Friend with a New Name

ONE of the most interesting announcements received during the current month comes from the Penton Publishing Company, publishers of "Iron Trade Review" for nearly fifty years. The announcement is to the effect that the name "Iron Trade Review" has been discarded, and that starting with the first issue of this month that publication will hereafter appear under the name "Steel." In explanation of this change, the publishers point out that steel has reached a dominating position in industry as a raw material which was formerly held by iron. Furthermore, new improvements in the production of many kinds of steel, including alloy steels, are furnishing industrial plants with a rapidly increasing assortment of raw materials which are more properly classified as steel than as iron. Research work in recent years has proven conclusively that it is possible to produce a steel to meet almost every requirement in the metal fabricating industry. The makers of steel, however, are fully aware of the competition which they may expect from the producers of many non-ferrous alloys which are being developed with equal vigor and with equal foresight. With this vision of the possibilities, the problems, and the promise of a greater knowledge of merchandising possibilities of steel in the future, it was a foresighted act on the part of the publishers to focus the attention of their readers on the new trend in construction by the new name which they have adopted for the publication, which has served the metal industries of this country for a couple of generations. An industrial trend of such importance as to bring about this change of name in one of our most influential business publications should not be overlooked by those who are interested in welding developments. The trend shows on what metal the greatest volume of welding will probably be done. This is borne out by investigations made last year which indicated that 70% of the welding in this country was steel welding. It is not possible to make anything like a quantitative prophecy of future developments, but it is safe to say that steel consumption will be the dominating influence on the volume of welding for a number of years to come.

Roebling



Welding Wire

Economy in time and efficiency in strength of welding by both Gas and Electric in the manufacture of many standard products; structural steel fabrication; building up and bonding steel rails; and repair of broken mechanical parts, have been proven beyond question.

Roebling Welding Wire is used where only the highest quality is acceptable. It conforms to all standard specifications in every detail and produces sound welds with the least trouble in welding.

Samples and Catalog A-529 will gladly be sent upon request.

John A. Roebling's Sons Company
Trenton, New Jersey.

Welding Tubular Structures

Effect of Excess Oxygen and Excess Acetylene on Welding Thin-Walled Tubing—Controlling Quality by Proper Arrangement of Welds—Results of Overheating

By E. F. Lake

OF all the work done on aircraft parts fabricated from steel, among the most important is the welding. There are many places where a weld could break, and it is easy to do a poor job of welding and hard for any one but an expert to tell good welds from bad ones by an optical examination. That is the only kind of inspection that can be given the finished product, as any other test destroys the part so it cannot be used.

Two or more pieces might be welded at one time and one of these might be given the tensile pull, torsion, vibrational, or other test, in order to judge the strength or fatigue resistance of the other piece that is to be put into use. A knowledge of how good or bad welds look to the eye might be gained in this way, but it is too expensive a proposition to use on anything but experimental work.

The color and condition of the surface of the steel after a welding operation will inform a person as to its strength and resistance to fatigue, if he has the natural ability and enough experience to read the signs left by the welding

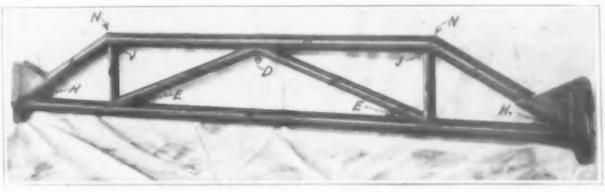


Fig. 1. Welded Spar on Which the Fuselage Is Built.
(Tube walls are 0.095 and 0.058 in. thick. End fittings of ⅛-in. sheet steel carry wing struts and landing gear.)

torch. But those who have acquired enough of this knowledge and skill to make an optical inspection reliable are not numerous enough to inspect all the welding that is now being done in the aircraft industry.

Therefore, it becomes necessary frequently to check up on all welding by the more scientific, accurate, and positive methods of microscopical examinations and tensile or fatigue resisting tests.

A correct balance of the oxygen and acetylene in the welding torch will produce a neutral flame that leaves the welded steel in its natural gray color. A slight excess of oxygen, however, will color the surface black as soon as the metal has reached a temperature of 400 deg. F. This black oxide of iron increases as the temperature of the steel is raised and as the amount of excess oxygen increases in the welding flame. Sometimes it gets thick enough to form scale, rise in blisters, or pit the steel surface. The steel is weakened just to the extent that the excess oxygen penetrates the steel to form FeO (ferrous oxide), which is the black color that eventually forms scale.

This scaling might not mean much loss of strength on a thick piece of steel, but when only 0.003 in. is scaled off a tube wall that is 0.035 in. thick, it has lost nearly 10% of its strength. Practical experience should teach one to judge by eyesight the loss of strength from this cause, but there should be absolutely no scale and no loss. A slight black color would not mean any appreciable loss in strength, but a perfect weld would leave the steel gray color.

When the welding flame carries more acetylene gas than the oxygen can consume it adds carbon to the steel at the weld. The higher the temperature of steel is raised, the more readily will it absorb carbon, and acetylene is very rich in carbon. Hence, when the steel reaches the molten state an excess of acetylene in the welding flame could raise the carbon around the weld to about 10%, whereas specifications for this chrome-molybdenum tubing call for only 0.25%. This might make the steel very brittle. The introduction of additional carbon only slightly changes the color of the steel surface at the weld, and consequently it takes more of an expert to judge its hardness or softness by visual examination.

Expansion and Contraction Strains

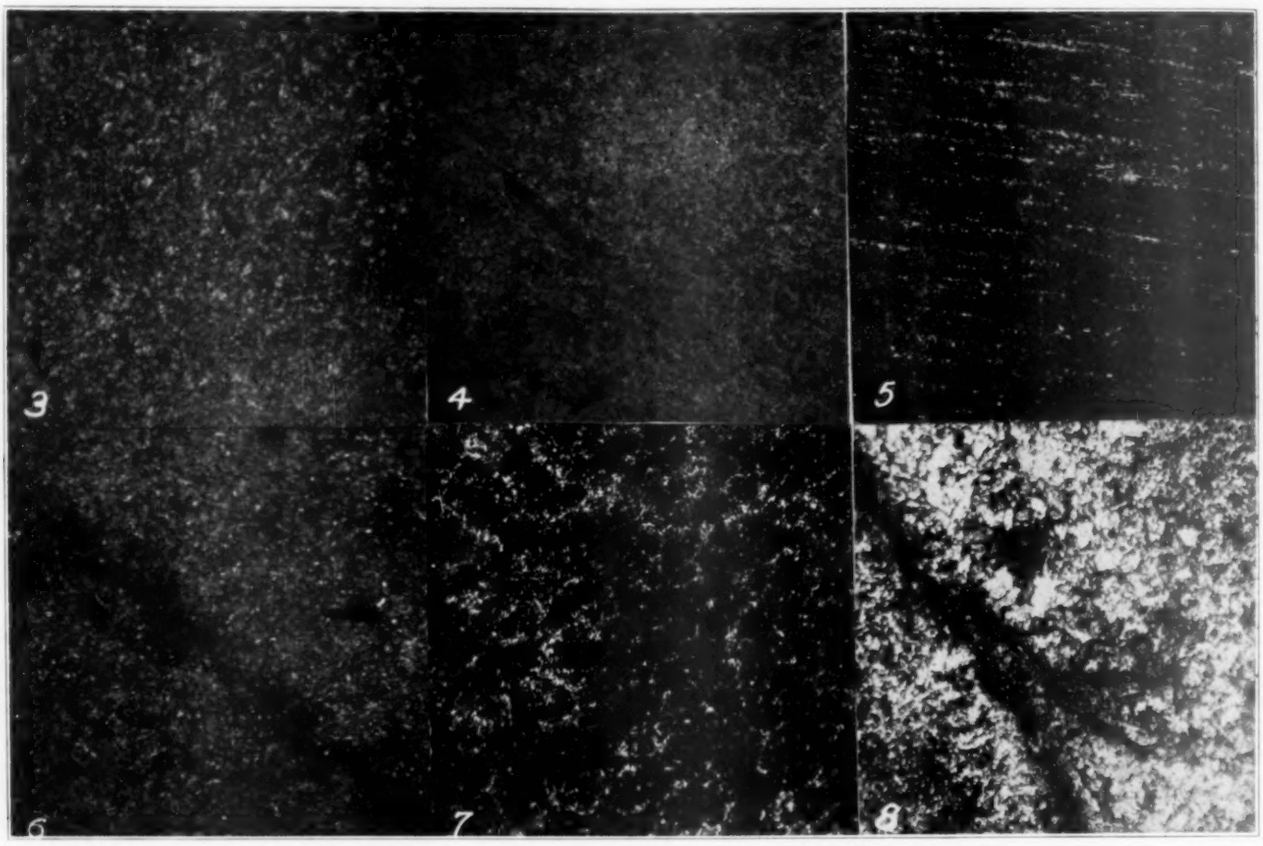
Tubes buckle at the weld if they are fitted in too tight to allow for the expansion that takes place when the steel is being heated for the weld. In other cases, the metal may stretch in the weld from the contraction that takes place when the weld is cooling down. When either this compression or tension is severe enough to change appreciably the physical properties of the tubing, it leaves marks on the surface of the steel which can be seen by the expert. Too much compression will produce a wavy effect on the surface of the tube even when it is not severe enough to cause a pronounced buckle. Tension strains beyond the elastic limit also leave their marks, and any one who has worked around a tensile-testing machine can tell by the appearance of the steel when it has been stretched beyond that point.

Fig. 1 shows a typical example of aircraft welding that might be full of strains. If this were clamped in a jig and completely welded, as shown, there would either be a compressive or tensile strain in every joint, and some have been

Fig. 2. Exhaust Manifold and Gasoline Heater.
(Welded and formed from 0.020-in. and 0.035-in. sheet metal, for Buhl Aircraft Company's 8-place cabin monoplane.)

severe enough to warp and twist the spar so much it could not be used. To overcome this condition, tubes *A*, *B* and *C* are the first to be placed in the jig for a tack weld at *D* and the complete welds at *E*. *E*. These *E* welds are all on one side of the tube *A*. which has a wall thickness of 0.095 in., and the welding contraction causes it to draw up on the ends, sometimes as much as ⅜ in. This would cause severe strains at joints *E*, *H* and *J* if the whole assembly were clamped tight in a jig and welded at one time. Therefore, tube *A* has to be straightened before any more welding can be done.

Next, tubes *K* and *L*. *L*. which are 0.058 in. thick, are held in the jig while joints *N*, *N* are being welded. These



Microstructure of Welded Tubing Magnified 200 Diameters.

Fig. 3. Grain Structure of SAE 1025 Steel Tubing (No. 2 in Table 1).
Fig. 4. Finer Grain of Chrome-Molybdenum Tubing (No. 13 in Table 2).
Fig. 5. SAE 1025 Tubing Which Stretched in the Weld Because the Metal Could Not Contract.
Fig. 6. A Tube Weld That Broke From Being Gripped So Tight That the Steel Could Not Contract When Cooling Down After Being Welded.
Fig. 7. SAE 1025 Tubing With Grain Coarsened from Too Prolonged a Heat When Welding (No. 9 in Table 1).
Fig. 8. SAE 1025 Tubing, Very Brittle from Steel Being Burned and Cracked During Welding (No. 10 in Table 1).

are butt joints that are not so liable to cause warpage, yet they have to be bent somewhat to make this unit fit the lower unit at joints *H*, *H*; this being the next operation. After that the two units are clamped in the jig for the welding of joints *J*, *J* and *D*. Joints *J*, *J* do not cause much warpage, but at joint *D* there is so long a weld on one side of the tube only that considerable expansion and contraction takes place. The writer has marked across the joint at *H* and seen the mark separate as much as $\frac{3}{16}$ in. while the welding was being done on joint *D*. This would cause severe strains in the spar if the joints at *H*, *H* were not left open to allow this expansion and contraction to take place. Therefore the tubes at joints *H*, *H* must be the last thing to be welded. After that the sheet-metal fittings at each end are welded into place. Holes are drilled in these for bolting on the landing gear and wing struts.

Fig. 2 is a good illustration of thin-sheet-metal welding. This is the exhaust manifold, muffler, and gasoline heater used by the Buhl Aircraft Co., on their six- and eight-place cabin monoplane. The exhaust manifold is made from 0.035-in. sheet steel to fit the Wright Whirlwind engine; while the mufflers and exhaust pipes are made from S.A.E. 1025 sheet steel that is 0.020 in. thick. The gasoline heater at *P* fits the under part of the engine. There is approximately 100 ft. of welding on this outfit and the most difficult is the longitudinal seam that runs the full length of the exhaust pipes. Considerable welding skill is required to keep this pipe round, straight, and free from buckles in this longi-

Table 1. Tensile Tests of Welds on Carbon-Steel Tubing

Standard Specifications for S.A.E. 1025 Aircraft Tubing			
	55,000	36,000	22
No.	Tensile Strength	Elastic Limit	Elongation
	Strength After Welding		
1	56,160	36,880	21
2	51,190	33,220	26
3	49,870	31,310	28
4	47,750	31,090	27
5	46,820	30,630	29
6	46,460	30,300	28
7	46,110	29,990	29
8	45,960	29,870	30
9	35,100	21,340	20
10	16,150	16,150	2

Table 2. Tensile Tests of Welds on Alloy-Steel Tubing

Standard Specifications for Chrome-Molybdenum Tubing			
	95,000	60,000	10
No.	Tensile Strength	Elastic Limit	Elongation
	Strength After Welding		
11	102,920	68,640	9
12	90,740	57,210	11
13	87,050	54,230	12
14	86,560	53,450	12
15	86,270	53,290	14
16	85,800	53,660	13
17	84,290	53,190	15
18	83,670	52,360	17
19	76,080	48,750	16
20	60,280	38,170	7

tudinal weld. To prevent such buckles and warpage only the smallest possible welds are allowable, and these must be extremely smooth as this outfit is located on the outside of the plane and exposed to the gaze of visitors.

Tensile Tests of Welds

Probably the easiest way to get a positive check on the strength of welds is with the tensile-testing machine. On the thin aircraft tubing this will not give the reduction of area, and that is the best factor of the tensile test on which to base the toughness of the steel and its resistance to fatigue. Therefore, we have to estimate this toughness and fatigue from the elongation and elastic limit.

In Table 1 are given ten tensile tests which are typical of more than 100 tests from which they were selected. Test No. 1 shows a greater strength than the S. A. E. specifications call for. This was probably due to the fact that the tube, before being welded, ran above the specifications in tensile strength and then had a low loss from welding. This is an exceptional case, however, which might not occur again in a thousand welds.

Tests numbered from 2 to 8 are the average run of welds which may be obtained by a good welder who is fast enough not to prolong the heat, always keeps a neutral flame, and does not burn the steel. When steel is heated above the critical temperature, the grain begins to coarsen and this coarsening of the grain grows as the temperature continues to rise. This grain growth also occurs if the heat is prolonged at any of the temperatures above the critical range. As fast as the grain grows in size, or coarsens, the cohesive force lowers and all physical properties are lowered. Such were the conditions giving the low test figures in test No. 9. In test No. 10 the steel around the weld was badly burned and showed cracks under the miscroscope.

Some 75 tests were carefully examined for the ten which best represented all these tests, the data on these ten being given in Table 2. No. 11 showed the highest physical properties of the entire 75 and was a freak which might not be encountered again. Some exceptional tests of this chrome-molybdenum tubing have shown a tensile strength of 125,000 lb. and such a piece may have been welded to give this figure of 102,920 lb. after welding.

When chromium is combined with nickel, molybdenum or vanadium, alloy steels are produced showing the highest tensile figures obtainable in steel, and also the highest resistance to vibrational strains, or fatigue. Welding does not reduce their physical properties as much as it does those of other steels, and numerous welds are made with a loss of only 10% or 15%. Tests from numbers 12 to 18 well illustrate this, and more than three-quarters of the 75 tests were within this range.

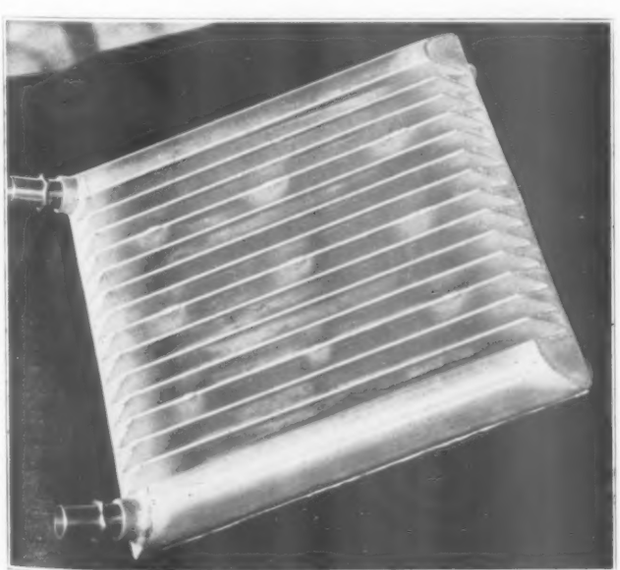


Fig. 9. An Exceptionally Good Job of Aluminum Welding.
(Oil-cooling radiator developed by Buhl Aircraft Company for use with Wright Whirlwind engine.)

Tests Nos. 19 and 20 show the lowest strengths of the 75 specimens examined. These low figures could be produced by an oxidizing or carbonizing flame in the welding torch, or from an overheating of the steel, or from a welding heat that was too prolonged.

Microscopical Examinations

Microscopical examinations give a lot of information about the condition in which the steel is left from welding and are well worth the cost even though they take more time and are more expensive than tensile tests. In Figs. 3 and 4 are shown photomicrographs of practically perfect welds at a magnification of 200 diameters. Fig. 3 is from the S. A. E. carbon-steel tubing which gave strength test No. 2 in Table 1, while Fig. 4 shows the much finer grain structure of the chrome-molybdenum tubing in the weld with the strength of No. 13 in Table 2.

In Fig. 5 a short tube which stretched in the weld was cut out of a fuselage for testing. One end was left for the last thing to be welded, and there was no chance for contraction to take place when the weld in this last joint was cooling down. Therefore, the metal stretched while the welded part was still hot and weaker than the cold tubing. The elongation of the grain structure in Fig. 5 shows the effect of this stretching, which lowers the physical properties. It was cut from the same tube as was photographed for Fig. 3 and should have the same grain structure. Some of the rolled steels show a similar grain structure, but when they are annealed or normalized the grain structure is similar to that shown in Fig. 3. This S. A. E. 1025 tubing is normalized before being used in aircraft parts.

In Fig 6 this stretching was carried to the extreme by butting two ¾ x0.035-in. tubes tight together and then clamping them so tight they could not move at all. After being welded, polished, and examined under the microscope, cracks like that shown were found at the weld, and they were doubtless caused by the steel not being able to contract when cooling. Such things show that tubes should never be welded unless they are loose enough to allow for expansion and contraction. One-sixteenth of an inch is a good allowance to leave between two tubes that are to be welded, if they are under 1¼ in. in diameter, but slightly more should be allowed for larger tubes. Too big a gap makes too wide a weld and weakens the structure, while no gap at all might cause the tube to buckle.

In Fig. 7 is shown how the grain of steel is coarsened by overheating. In this case the microphotograph was taken before the tensile pull was made and test No. 9 in Table 1 shows how much the strength of the steel was lowered by this coarsening of the grain.

In Fig. 8 can be seen how the steel in a weld looks when it is so badly burned it is full of microscopic cracks. Its lack of strength is shown by tensile test No. 10 in Table 1. With practically no elongation, it shows great brittleness.

Fatigue of Steel

Resistance to fatigue is of more importance than tensile strength to aircraft steels, as the fuselage steels especially must withstand the rapidly repeated vibrational strains that come from pulsations of the engine; from running over the rough ground of a landing field, or from air currents that cause tail surfaces or other parts to shimmy and flutter. Continuous and rapidly repeated strains of this kind do more damage than occasional severe strains that are below the yield point.

The endurance flights that took place last year were the very best tests that could be given steel tubing and welds for their fatigue-resisting properties, as no machine has yet been devised which will give the resistance to vibrational strains on the thin steel tubing used in aircraft construction. Therefore, we have to resort to other kinds of tests; get special test bars made, and compare different batches of steel to find which is the best to use. Two of the best of these endurance flights were that of the new Curtiss airplane that stayed up over 400 hr., and the 274-hr. flight of the Buhl Sedan, after it had flown on commercial routes of over 65,000 miles. Owing to the expense being so great, we seldom get the chance to test steels when in actual use as we did here.

Aluminum Welds

In Fig. 9 is illustrated the best job of thin-sheet-aluminum welding that has come under the writer's observation. The straight joint along the side is some 15 in. long and does not show any sign of a buckle. Most welders know how difficult

Fig. 10. Sheet Aluminum Formed Into Wing Fittings With the Aid of Welding, by the Buhl Aircraft Company.

it is to keep such a joint straight when the sheet aluminum is only 0.035 in. thick. Usually a joint gets full of buckles which have to be straightened. This causes breaks that have to be re-welded, destroying the smooth appearance of the job. Welding the ends to the corrugated top and bottom was also a smooth, neat job that did not show a buckle in any place. This is an oil-cooling radiator that the Buhl Aircraft Co. found necessary to install on a Wright Whirlwind engine for summer flying over Texas and other hot districts. Fig. 10 shows some wing fittings fabricated by welding sheet aluminum into the desired shapes.

SAN DIEGO LAYING NEW WELDED WATER PIPE LINE

The city of San Diego, Calif., is increasing their water supply by the laying of a new pipe line to be known as the San Diego second main pipe line, coming from the Otay reservoir, some twenty miles distant from San Diego. The

San Diego Will Depend on This Welded Pipe Line for Its Water Supply.

line will parallel and eventually replace the present main pipe line, which was built about twenty-eight years ago of redwood staves held together by steel bands, and which is now in a precarious condition.

This new pipe line, which is shown in part in the accompanying illustrations, will have a total length of about nineteen miles. The first eight miles will be a 40-in. line, all electric-arc welded. The next eight and a fraction miles will be 36 in. in diameter, also all-electric welded. The thickness of the pipe will range from $\frac{7}{16}$ to $\frac{3}{8}$ in. and will be dipped and wrapped with Pabco.

Fabrication of the welded pipe, dipping, and wrapping is being done by the Western Pipe & Steel Co., of California,

Laying and Welding Pipe Line in the Field.

at their South San Francisco shops, and this company also has the contract for installing the line, this being handled by the Los Angeles organization.

The pipe line will pass through four tunnels with an estimated tunnel length of 7,200 ft. The gravity carrying capacity of this new pipe line will be about twenty million gallons of water per day, which will increase the present water supply nearly 50%.

The project is under the supervision of H. N. Savage, hydraulic engineer, and T. V. Huff, chief welding inspector for the city of San Diego.

C. G. M. A. SUMMER MEETING

The attendance at the summer meeting of the Compressed Gas Manufacturers' Association slightly exceeded the best of previous years. On Thursday evening, June 19th, the Executive Board held their regular meeting which was followed by discussions of interest, particularly the sport program that was arranged for the days to follow. President Colby traveled down from Montreal to preside and to meet his associates during the period of relaxation that followed the business session.

Three official rounds (54 holes) of golf composed the golf tournament and prizes in abundance were placed in competition. In addition to these regular prizes offered for proficiency of one kind or another, the contestants competed for the permanent trophies, which were the H. S. Smith trophy, the J. C. Minor cup, the Millholland cup, and the F. A. Johnston trophy, also special prizes offered by The Ingersoll-Rand Co., the Worthington Pump and Machinery Co., and by President J. R. Colby. Prizes were given for the best scores in contract bridge and also auction bridge.

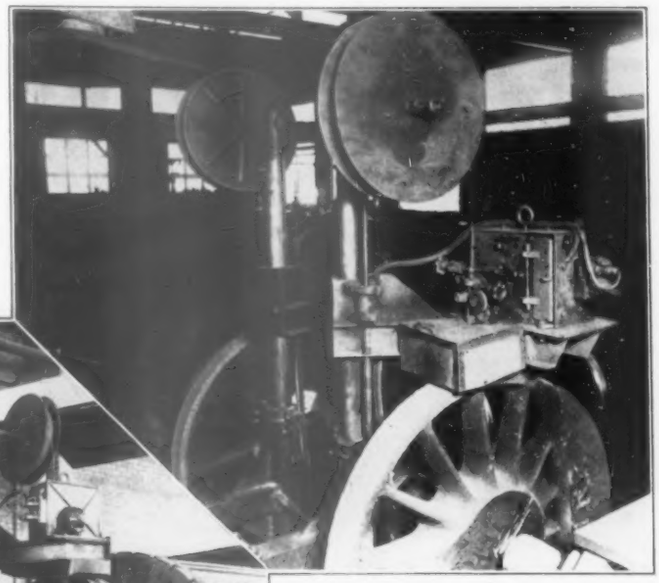
Automatic Welding in Railroad Shops*

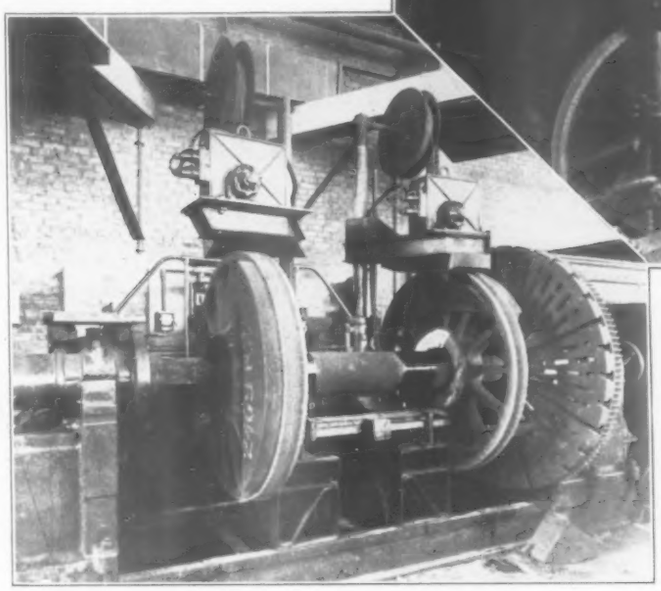
By Means of a Built-Over Lathe and Automatic Welding Heads. Wheel Centers Are Built Up in Much Less Time Than Formerly

By G. H. Logan†

THE problem of maintaining fixed diameters and true circles on locomotive wheels, which has confronted the mechanical department of almost every railroad, has been solved in the shops of the Chicago & North Western Railroad through the application of automatic electric arc welding for this purpose.

The method in general use for changing the tires of locomotive wheels is to heat the worn tire until it expands sufficiently to allow slipping it off the wheel center and then replacing it with the new tire which has been expanded by heating until it readily fits the wheel center. The new tire is then allowed to cool and, in cooling, shrinks upon the wheel center, assuring a tight fit. Although this is by far the quickest and cheapest method of replacing worn tires, because the change can be effected by merely disconnecting the tender, removing the driving rods, slackening the brake rods, and jacking up the engine to a height permitting the flanges to clear the rails, yet it reduces the diameter and destroys the perfect circularity of the wheel centers. Eventually, the wheel center thus reduced and deformed must be built up by welding and then machined.





Above—View of Automatic Welding Heads.

Left—Depositing Metal on the Outside Surfaces of Worn Driving-Wheel Centers.

Below—Expanding a Tire by Means of a Gas Flame.

Replacing Worn Tires

The tires to be removed from the locomotive-wheel center are usually heated by pipe rings or hoops which slip over the tires. These pipes contain a number of small holes from which jets of flame, caused by burning natural gas or gases generated by fuel oil, kerosene, or gasoline under air pressure, issue and come in contact with the outer surface or tread of the tires, causing the tires to expand sufficiently to be slipped off the wheel centers. The wheel centers are then calipered; the new tires, or tires which have been turned on arbors, are gaged for bore diameters; and if the bore is too large to permit a tight fit with the standard shrinkage allowance, the proper thickness of shim must be inserted between the tire and the wheel. The new tires are hung on their respective wheels and heated and expanded so that they will slip over the wheels; shims are applied where necessary; the tires are set to their proper locations and allowed to cool and contract on the wheels.

As previously stated, a continuation of this process reduces the diameter of the wheel center and has a deleterious effect upon the roundness of the rim section until it

*Superintendent of Shops, Chicago & North Western Railroad.

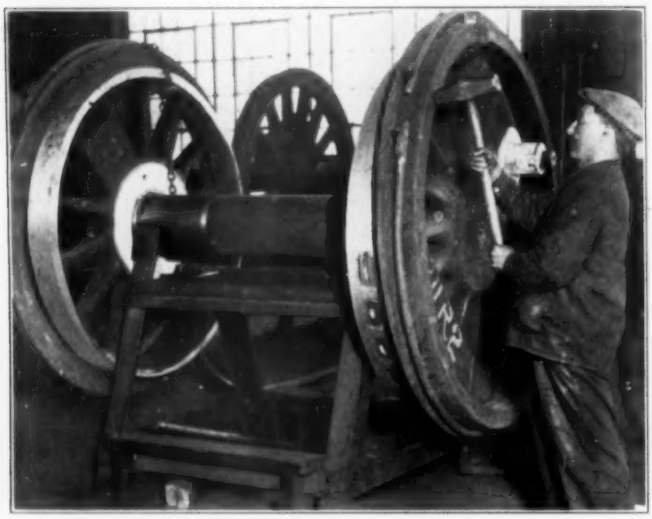
becomes necessary to build up the wheel center.

The reducing and deforming effect of this method of changing tires is traced to several causes. The principal cause is the contraction stress inherent in all irregularly shaped castings. Because wheel centers are cast steel and the light spoke and rim section is opposed by the heavy hub, crank pin, boss, and centerbalance section, the contraction strain on the lighter section of the wheel is excessive, deforming the wheel to some extent. In addition to this strain, caused by the contraction of the wheel center itself, there is the contraction strain imposed by the shrinking of the tire upon the wheel; this strain tends to increase the concavity of the wheel on the inside, thus reducing the diameter.

Irregularities in the track, such as gaps in the rails at crossings and low joints in the rails, subject the heavily loaded wheel centers to considerable pounding, which decreases their diameters. This is especially true when running at high speeds.

Building Up Wheel Centers

In the past, to care for undersized wheels which could not be made to accommodate the tires even with the use of our maximum thickness of tire shims, which is B.W.G. No. 10 gage steel, we welded up the entire wheel rim by hand. The best time we could make by this method averaged 35



Replacing the Tire on the Machined Wheel.

hr. for one 68-in. wheel, or 70 hr. per pair. Because the cost and time involved in welding by this manner were excessive, inquiries were sent to other railroads to ascertain their methods of caring for undersized wheels. It was found that two roads used automatic welding heads for this purpose.

We redesigned an old wheel lathe to swing on a 74-in. wheel center, and, by use of reduction gearing and a variable-speed motor of 450 to 1350 r.p.m., we obtained lathe-spindle revolutions of from 3 to 9 per hour and a varying feed of from ⅛ to ¼ in. per revolution. We purchased from the Westinghouse Electric & Manufacturing Co. two 300-amp. portable electric welders and two automatic welding heads. Suitable holders for welding heads were made, and the machine was put in operation on June 28, 1929, under the direction of a service engineer from the Westinghouse company. It was evident at once that a real solution of the worn-driving-wheel problem had been found.

Automatic Welding Seven Times Speedier

A very good job of welding was done, and with $\frac{3}{16}$-in. welding wire the surfaces of a pair of 68-in. driving-wheel rims were welded in 9½ hr., or 4¾ hr. per wheel, as compared with the handwelding time of 35 hr. per wheel—a time saving of 30¼ hr. per wheel, or 60½ hr. per pair.

These wheels however were only slightly smaller than the standard diameter, and we find that with most wheels we must make two runs across to obtain sufficient stock for turning. A good average time for two runs is 20 hr. per pair, which effects a time saving of 50 hr. compared with the old hand-welding method. It is our belief that with 500-amp. welders we could use $\frac{5}{16}$-in. welding wire and build up most wheel rims with one run.

As engines go through our shops we weld up any of their wheel centers which are undersize, and in addition we weld up undersize wheel centers which are sent in from points on our road. With the adoption of automatic welding, we feel assured that all our troubles in connection with caring for undersize wheel centers are practically ended.

Realizing the possibilities of automatic welding heads, we have fitted up also an old 26-in. engine lathe, 10 ft. between centers, with suitable holders for welding heads, and we drive the lathe with a variable-speed motor operating at 500 to 1500 r.p.m. With the back gears engaged, the speed range is from ¼ to 3 r.p.m., and with the back gears out, on direct drive to cone pulleys on the spindle, we have a speed range of from 3¼ to 36 r.p.m. Carriage travel is provided by the thread-cutting gears and varies from 0 to 19½ in. per min.

A lathe is used because it permits the performance of both straight-line and circumferential welding on one machine.

Cuts Time of Building Up Guide Bars in Half

At present the building up of worn side surfaces of locomotive guide bars constitutes the major amount of work performed on the machine. Where the average welding time required to build up one guide bar by hand was 12 hr., the use of automatic welding has reduced the time to 6 hr. We expect to lower this time in the near future by using 500-amp. welders and larger welding wire.

Automatic welding has other uses in a railroad shop. Worn shafts, pins, etc. can be welded up circumferentially and turned to the desired diameters; and large steel bushings (used in solid and main rods) which have become loose in the rods, while the bore of the bushing is practically of the original diameter, can be built up by automatic welding and again machined for application to the rods. A large saving over the cost of new bushings is thereby effected.

We believe that automatic welding heads are a positive necessity in a locomotive repair shop because of the saving in both time and material they unquestionably effect, and we know that their use for the building up of wheel centers alone has justified their installation in our Chicago shops.

DEATH OF ELMER A. SPERRY

Elmer Ambrose Sperry, capitalist and renowned inventor, died on June 16th in Brooklyn, N. Y., from complications which set in as the result of an operation six weeks before. He was born in 1860 in Cortland, N. Y., where he received his early education, later attending Cornell University. A successful inventor before the age of 20, he attracted world-wide attention as many inventions of great importance followed one after another through the remaining fifty years of his life. Such included the gyroscope, a high-efficiency Diesel engine burning low-grade fuel oil, the metal-flow detector, and—among his recent inventions—a searchlight many times more powerful than its brightest prototype, and a magnetic means of finding the location and extent of flaws in rails, welds, etc. He was a member of many technical societies and a founder of two.

Welding in a Gun-Sight Factory

The Brazing On of "Beads" and Altering of Rifle Bolts Give the Welder an Opportunity to Display His Skill in Work Requiring Great Exactitude

By J. C. Coyle

GAME is not plentiful as it once was, and the open season on some kinds of big game is very short in most states. The sportsman of today must look to his gun sights, as on them depend largely the results of his two or three days' sport. There are a great many sizes and types of sights in use on shot guns, rifles, pistols, and revolvers, from half the size of one's little finger nail up to telescope sights several inches long. The manufacture of these sights, because of the need for accuracy and the small size of the product, was originally a slow and tedious process.

The need for quantity production, however, has brought about the development of special machines and jigs for faster operations. Both acetylene and electric welding have played an important part in the improvement of manufacturing methods used in the factory of the Western Gunsight

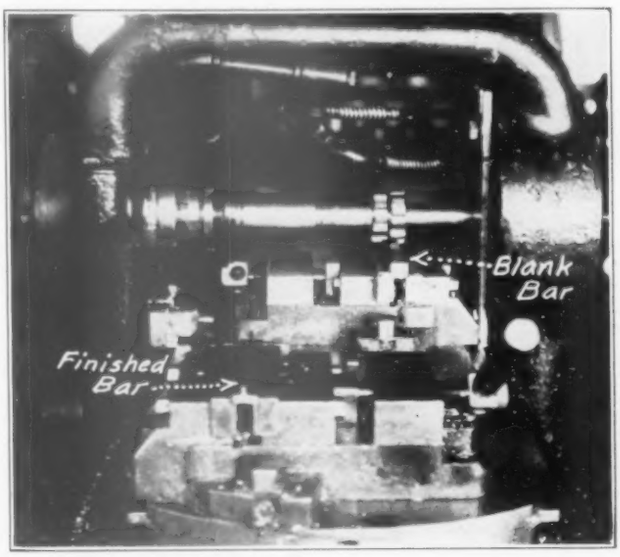
Brazing "Gold" Beads on Gun Sights.

Co., of Denver, Colo. Though the operations involving welding are few, they are nevertheless essential ones. For instance, the "gold" beads on various sizes and types of front sights are all brazed onto the steel.

Cutting and Milling Front Sights

The methods employed in the manufacture of standard front sights are good examples of factory practices. This type of sight is made from 5-in. bars of Bessemer steel, each bar being cut into five sights. One of these bars is clamped between the jaws of a vise, at each end of a reversible jig attached to the carriage of a milling machine. After one bar passes through a pair of side mills the jig is reversed, and the milled bar is removed and another substituted while the second bar is passing through. The bars are later sawed into five sights each, while held two at a time in a special jig on the same machine. Each corner of the base is next cut out on a special jig on a punch press, one sight being handled at a time.

The next operation—cutting the dovetail in the base of the sight, with a 6-deg. taper, for entering the slot in a gun barrel—is performed on a milling machine which has been worked over to adapt it to faster production. A shorter hanging arm than usual is applied to this machine, milled out at the back for the addition of a built-up jig in which two extra pairs of mills are mounted. The horizontal mill on the regular tool arbor roughs the bottom of the sight, and the dovetail is cut and the corners roughed by the two extra pairs of vertical mills. One sight is placed upside down



Tooling Five-Sight Blank Bars with a Miller Equipped With Reversible Jig.

in each end of the jig, which is similar to the one already described. While one sight is being milled the other is removed and inspected and another one inserted.

Applying the "Gold" Bead

If the sight is to receive a "gold" bead (high grade bronze) the latter is placed between the jaws of a special holding jig on a miller, and a longitudinal slot milled almost the length of the bead. The steel tip of the sight is inserted in this slot, and the whole is dipped in naphtha to insure a clean joint. A mixture of fine bronze and borax brazing compound is then applied to the joint.

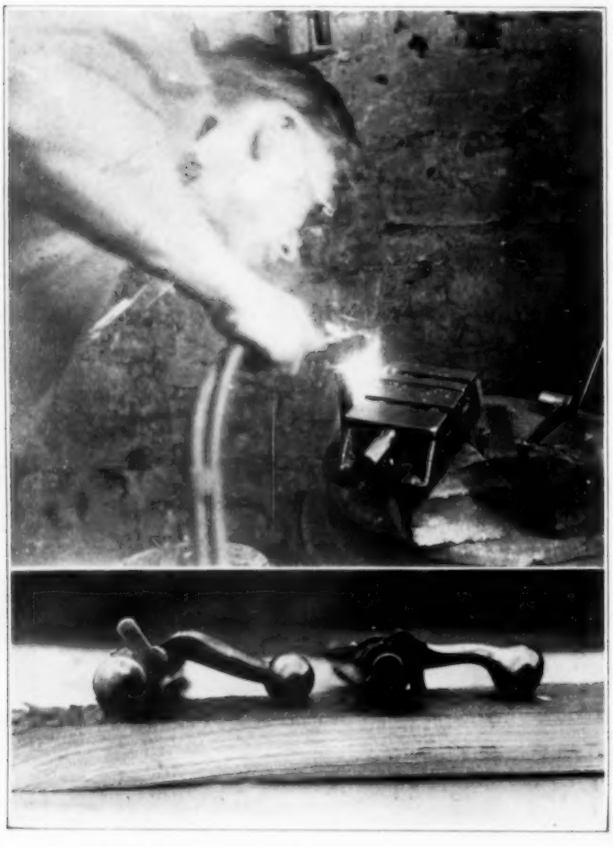
The sights are grouped on a square piece of board, holding approximately 100 sights each. They are then placed, one at a time, in a resistance welder and brought to a brazing heat. The boards containing the groups of sights are placed within easy reach of the operator to speed up the work. Two hundred sights per hour are brazed in this way. The welding apparatus was built in the shop and adapted to the unusual nature of the work, one of the carbon electrodes being shaped to take the bead and thin edge of the sight. Current is supplied by a 220-volt transformer. Only skilled labor can be used.

The sight is next finished on a vertical miller, using a special jig on the carriage, with jaws made to fit the dovetail on the sight. One side of the sight and bead is milled as it

goes through, then the jig is thrown to one side and the other side milled on the return, giving the sight a slight taper from one end to the other. The sights are then filed at the bench to remove any irregularities, and polished with emery on block wheels. They are then blued, in quantities up to 10,000 per day, in a pot of manganese oxide and saltpeter, at a temperature of 850 deg. F., and cooled in oil. After another polishing they are ready for the market.

Altering the Bolt Shape by the Saw and Torch

Many jobs are done to order at the factory, such as adapting the Western telescope sight mount to Springfield, Mauser, Savage, and other rifles. The Western "scope" mount brings the "scope" much closer to the barrel of the



(Top) **Welding a Breech Bolt.**
(Center) **Original Bolt Shown at Left, and Bolt as It Appears After Cutting and Welding, Shown at Right.**
(Bottom) **Detail of Cutting and Assembling Bolt by Welding.**

gun than other makes, and to accomplish this desirable result it is necessary to alter the shape of the breech bolts on these types of rifle. This is done by skillful cutting and welding. The bolt is removed from the rifle, heated to a cherry red, and then sawed through the heavy part of the bend with a power hack saw. The end of the outer section is sawed to a wedge shape and the parts are then cooled and dipped in high-test gasoline to clean the surface, then replaced end to end in a holding jig, with the wedge point of the outer section at the lower extremity of the other piece. The bottom and top of the joint are then built up, with vanadium and nickel rod, after preheating the parts to the fusing point. The open joint precludes any likelihood of a bad weld. A No. 4 torch tip is used. To insure a perfect job but one bolt is altered at a time, the welding operation taking one man about 10 min.

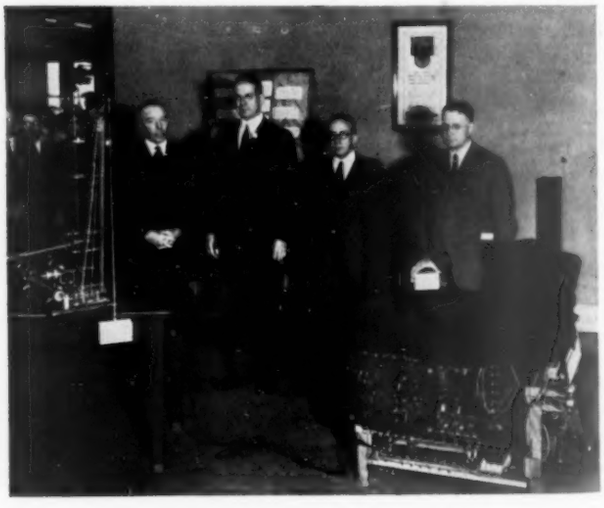
The bolt is then milled, polished and heated to a cherry

The Round Tin Holds Knife-Blade Sights, the Square Tin Contains "Gold" Beads Ready to Apply, and in the Rear Are Fluxed Sights Ready for Brazing.

red and plunged in oil. It is allowed to cool and then reheated to 850 deg. F. to draw the temper to the proper point and blue the part, and plunged again into hardening oil. Another polishing completes the process.

REPLICA OF CORNERSTONE IS LAID AS ACTUAL STONE FOLLOWS MOVEMENTS

The illustration is that of W. S. Rugg, vice-president of the Westinghouse Electric & Manfacturing Co., laying the cornerstone of the new arc-welded engineering laboratory, erected by the company. As Mr. Rugg placed the model stone in position, delicate relays controlled by an "electric eye" operated the hoist that swung the actual cornerstone into place. The real stone, and a model on a crane at the right of Mr. Rugg, exactly followed his movements as he



Westinghouse Officials at Cornerstone Laying.

placed the model stone in place on the model building. He then pronounced the stone well and truly laid. The ceremonies in the room where Mr. Rugg laid the model stone were far removed from the actual building site.

This $2,000,000 laboratory, which at the time of its completion will be the largest and tallest arc-welded structure in the world, will contain 25 elaborately equipped laboratories for nearly every branch of the electrical industry. In them the most strenuous and exacting conditions will be created for the study of their effects upon electrical apparatus.

Spot Welding in Structural Work

Units of Thin Steel Sheets Quickly Fabricated in the Shop by Using Automatic Spot-Welding Equipment of Special Design

By John H. D. Blanke

IN A RECENT issue of Science & Industrie, M. L. Lenouvel, an engineer in the Citroen factory in France, furnishes an interesting review of some of the more recent developments in electric resistance spot welding equipment, indicating the range of use of resistance welding from the manufacture of jewelry to the manufacture of such heavy articles as railroad equipment and parts of metal houses. The machines described in the above mentioned article have been developed by the Societe La Soudure Electrique.

One of the most interesting of the machines described is a spot welder which is being used in the fabrication of railroad cars. It is said to be one of the most powerful machines in service in Europe. It is so constructed that it can be set up and operated as a stationary unit or it can be made more flexible by having it suspended by chains from a traveling crane so that it can move around the work. Instead of the conventional castings used quite commonly on spot welders of such large capacity, this machine is constructed of steel, riveted and welded, and it is designed to be strong enough to allow a pressure of five tons at the electrodes. The fact that this machine can be used either as a stationary one or as a semi-portable unit makes it possible to increase the number of applications of spot welding in the plate fabrication on cars and thus do away with many of the operations involved in riveted construction.

A particularly interesting portion of Mr. Lenouvel's article concerns the application of spot welding to steel house construction. This is a subject which is receiving considerable attention at the present time, because there are so many obvious advantages to steel construction, and at the same time comparatively little has been done in the matter of designing satisfactory units. If steel is to replace wood on a very large scale in the construction of small buildings, experience has shown that it is going to be most economical to do a great portion of the fabrication in the shop so that the different parts will be ready for quick assembly when it comes to a matter of the actual erection of the building.

Parts of steel structures have been fabricated by spot welding for a good many years. This is particularly true of light structures such as trusses, door and window frames and partitions; but those who are interested in the promotion of the more extensive use of steel for buildings feel that there is a big field here for more extensive application and that this development involves research in the designs to be used so that full advantage may be taken of all of the physical properties of steel, allowing the use of the least possible weight to get the necessary strength.

"There was much talk about metal buildings on the occasion of the recent exposition of Modern Buildings," states Mr. Lenouvel. "Among them the H. C. multicellular houses have given rise to new and interesting applications of electric spot welding.

"The constitutive element of these houses (see Fig. 1) is composed of a lattice girder formed of two fluted flat sheet irons A and A′ of 0.4 mm. thickness whose spacing is maintained by the Z's, also of fluted sheet iron of 0.4 mm., the whole then being closed on the sides by the side pieces B and B′ of 0.4 mm. sheet iron. These girders are placed side by side and welded to form the panels which constitute the walls or the floors.

"A house of four rooms requires about 250,000 spot welds which shows how important it was to provide special and high speed machines for this work. The polishing machine had been disregarded because the use of clean sheet iron could not be considered for reasons of economy.

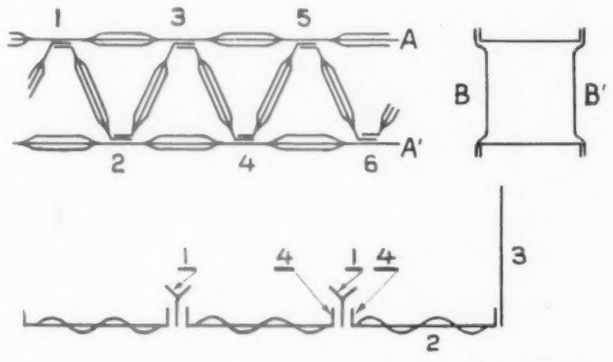
"The three principal problems which M. Languepin, the designer, had to solve were the following (see Fig. 1):

"1. Welding of the Z's to the sheet irons A and A′.

"2. Fixing the side pieces B and B′ to the girders whose length is 8 meters for the floor girders.

"3. Joining of the girders to each other for building the panels.

"For this work the Societe La Soudure Electrique has developed machines making 240 spots per minute during which the machine or the piece is shifted. In order to obtain rapid shifts, however, an ingenious arrangement patented by M. Bourdelle in March, 1929, has been applied



Illustrating Assembling of Girders and Panels by Spot Welding.

with success. The machine being fixed and the object mobile, this arrangement consists in carrying the object along by a spring carried along itself by a continuous movement. The object is rendered immovable when it is pressed by the electrodes and the light spring; as soon as the electrodes turn aside, the object is quickly drawn forward again by the spring.

"If, on the other hand, the object is fixed, one interposes a spring between the tips and the moving gear of the machine.

"1. **Welding the Z's to the sheet irons A and A′.**

"This welding consists of 30 spots spaced 9 mm. on the lines 1, 2, 3, . . . perpendicular to the plane of Fig. 1 and joining 3 sheet irons of 0.4 mm. The machine consists of two heads which do the work automatically, the heads only shifting themselves between each spot.

"The machine is supplied with a motor which drives satellite reducers whose one part is held by a band brake which forms the clutch of the machine. The speed reducer controls by a cam the movement of the electrodes and controls at the same time the shifting of the machine.

"The machine goes forward only while placing the welding spots at the speed of 240 per minute, and arriving at the end of the run of 25 centimeters, it stops automatically.

At this moment the electrodes turn aside 60 mm. when normally they turn aside not more than 10 mm. at each welding spot and the machine returns to the starting position. This movement is intended to permit the passing above it of the framework.

"The backward return of the machine allows the displacement of the piece, which is done automatically. The duration of the operations is as follows:

Welding movement	10 seconds
Return movement	2 seconds
Lateral displacement of the object	3 seconds

"2. **Fastening the Side Pieces B and B'.**

"The girders are placed on a traveling roller table at the middle of which a chain rotates continually at a speed of 15 meters per minute. At the two sides of the girder there is a welder controlling the movement of the electrodes. The operator locks a spring on one hand to the extremity of the girder and on the other hand to the chain through a tip entering between two rollers. The girder part, also, stops automatically, during which time the points are closed, making a bound ahead from which it turns aside for stopping anew at the next welding point. Thus, two lines of welding spots are obtained at a linear speed of 15 meters per minute.

"3. **Joining the Girders to Each Other for Fabricating the Panels.**

"These panels being about 8 meters long and 3 meters wide, required the adoption of the following measures:

"The girders being placed one near the other on a floor, a pneumatic adjustable welder is shifted above them along the welding lines. This welder is supported by a carriage rolling on a light bridge drawn by a chain with interposition of a spring permitting the carriage to be rendered immobile during the welding and placing the welders back quickly before any of the points turn aside.

"The study and the construction of the machine presented a certain number of difficulties which arose from the shape of the pieces.

"The strips of metal placed between the two sides to be joined present on their upper part two projections which give a section Y (Fig. 1) designed to retain the lining. This makes the place where the welding spots come very barely accessible. The sheet iron 2 forming the upper part of the girder is fluted as has been indicated elsewhere, and the height of these flutings also limits the passage of the electrodes. The strip on which the spots are placed should be as narrow as possible and by reason of the low rigidity of the assembly before welding it must provide the possibility of slight deformation of the surface of the sheet iron and of the parts to be welded together, whether in the vertical direction or in the horizontal direction.

"Then for the establishment of the side joints the assembly of girders carries insertion pieces at certain points at 3 (Fig. 1) which have a height of 250 mm. above the welding plane. The horizontal distance between these pieces 3 and the welding line not being 250 mm., the total obstruction of the machine must not exceed this dimension on each side of the welding axis.

"The necessity of obtaining a high production and consequently a rapid displacement of the welder, limits the weight of the machine.

"These various reasons have lead to the choice of compressed air as a means of operating the adjustment of the electrodes, both of which are mobile. To prevent the friction of one of the electrodes against the welding pieces, from producing an abnormal wear and irregularities in forward movement, it was necessary to provide for the simultaneous displacement of the two electrodes. The machine contains therefore two cylinders placed in line with the electrodes and a little above with provision for taking up the strain due to its inclination.

"In order to allow for the possible differences in height, the machine is suspended elastically so as to hold very lightly on the two iron sheets by means of small wheels placed so as to pass between the flutings. Small wheels with vertical axes likewise direct the machine, making it follow the undulations on the welding lines and preventing the friction of the electrodes.

"The operation is assured in the following manner:

"An endless chain is installed horizontally along the length of the bridge and attached by a spring to the machine which rolls on the flange of the bridge girder. The motor which controls the movement of the chain likewise controls two cams which act on the circuit breakers. One of these cams operates the electromagnetic valve placed on the machine, which sends the air to the cylinder, while the other controls the welding current by means of an electro-magnetic contactor.

"The weld is simply automatic with constant time. There had been originally installed an automatic circuit breaker varying the duration of passage of the current according to intensity; practice has demonstrated that this apparatus is not necessary, the few irregularities which it can produce by reason of the condition of the sheet iron being negligible. The sheet iron employed is ordinary black sheet iron.

"This special manufacture has given place to other studies such as machines for welding the strips end to end before passage into the fluting rollers which work thus continuously. This welding is obtained by an automatic machine which makes a back and forth travel over the strip and welds with tips nearly in contact."

USING ROPES AROUND FIRES

For years those who have been interested in the sale of oxy-acetylene equipment have been trying to instruct users of their products to be careful in the operation of the equipment so that sparks do not fall in places where they may start fires and cause damage to property. The individual workman has as much to gain as the boss by being careful. A factory put out of commission by a fire of any kind means a period of unemployment and a loss not only to the one whose carelessness brought about the fire, but also to his fellow workers.

In the New York "Times" for Sunday, June 8th, a story was told of a workman on one of the bridges over the East River who lost his life on account of the carelessness of a torch operator and the man in charge of the work. The story is that the man was working on a platform under the bridge with a torch. Sparks fell from the job onto the rope which held the platform to the bridge. The operator, who had not noticed this, continued his work until the rope parted, causing one of the workmen to fall in the East River, where he was drowned.

Rope should not be used to hold a platform where any kind of a fire is in use whether it is a welding or cutting torch, a forge, a band burner or a gasoline blow torch. A spark from any of these will do the same damage. The safe thing to do is to use metal cables instead of rope. Asbestos blankets placed under the work might serve the purpose of catching the sparks. In crowded places where blankets could not be used a good proposition would consist of wetting down everything before starting the work and keep it wet until after it was finished.

The oxy-acetylene torch is one of the most useful tools ever produced for the industrial world. If properly handled it needs only common sense to operate it safely and efficiently. It is coming to be used more and more with building construction. If the operator will remember to help himself by taking no chances, by working under safe conditions and by being careful he will not only protect his job, but will get more out of it in the long run.—*International Acetylene Association Forum.*

Better and Cheaper Jigs and Dies

Welded Steel Dies and Jigs Have the Advantage of Holding Their Size and Shape With Age, Besides Standing Much Abuse, and Being Generally Cheaper

THE making of welded dies and jigs has turned out to be a successful and profitable business to the Milwaukee Welded Steel Corp., 1350 Burnham St., Milwaukee, Wis. Although the chief business of this concern has been the making of welded shop furniture and general job-shop work, they entered the business of making welded steel dies and jigs to meet the demands of some of their customers for such products, and also to supply their own needs along this line.

As a result of the knowledge gained in the production and use of such dies and jigs, they have sold the advantages of such products to others and thus have obtained new customers and an increased business. The contacts thus made with various firms and industries have greatly broadened

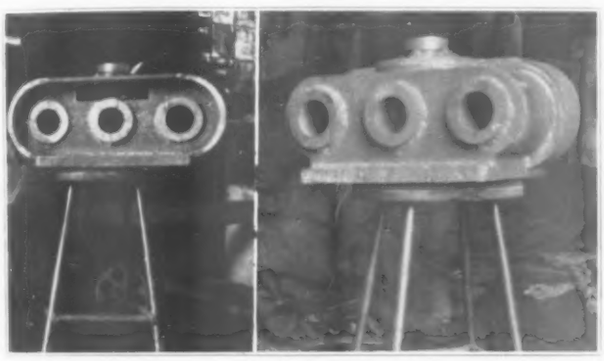


Fig. 1. Two Views of All-Welded Three-Spindle Index Head.

the reputation of this company as welding experts, and now many firms consult them whenever problems of maintenance or production come up in which welding might be used.

Thus the entering of this new line of manufacture has acted as a double-barreled gun in producing business: It not only has made a demand upon the facilities of the plant for making dies and jigs but has resulted in new jobs in the nature of welded repairs and in contract production work

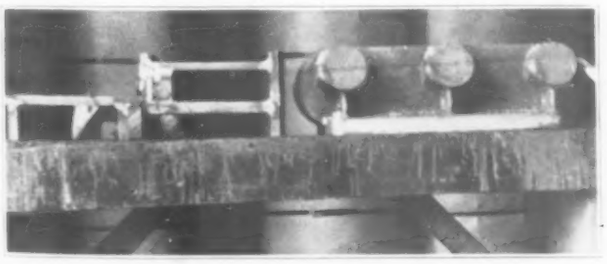


Fig. 2. Drill Jigs and Tail Stock Made of Welded Parts.

which have come as an indirect result of the new contacts made in carrying on the new business.

A comparison of first costs between welded steel jigs and cast jigs is generally favorable to the welded product—sometimes decidedly so—but another factor that is hastening the adoption of welded jigs is the trouble that is frequently experienced by shrinkage or distortion in the cast product as it ages. The welded steel jig holds its shape indefinitely, thus assuring no variation in the products as they come from the jig.

One of the most interesting jobs made in this shop is the three-spindle index head, two views of which are shown in Fig. 1. This jig contains only about one-half as much material as in a casting designed for the same purpose. Being all steel, it does not shrink or warp with age, and it will stand abuse much better than a cast-iron jig, without cracking. The views are of the jig after welding and before finishing. To finish this jig, only a few cuts are required on a milling machine.

This jig is made up of three pieces of seamless tubing, a cold-rolled boss, one piece of 1-in. boiler plate, a piece of

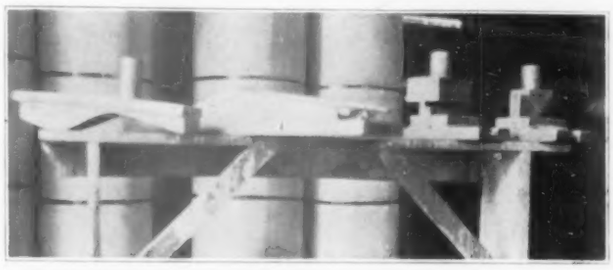


Fig. 3. Examples of Dies Made by Welding.

7-in. standard pipe, and several pieces of ⅜-in. boiler plate. The 7-in. pipe is cut in two, each half forming one of the ends of the jig.

An arc-welded tail stock for a three-spindle index machine is shown at the right in Fig. 2. This consists of pieces of ⅝-in. and ⅞-in. boiler plate, a short length of seamless tubing, and three short lengths of 2½-in. cold-rolled steel and the same number of pieces of 1½-in. cold-rolled steel. The seamless tubing is cut in two and welded to form the ends of the jig, similar to the two halves of 7-in. pipe in the jig shown in Fig. 1.

The other two jigs shown in Fig. 2 are drill jigs formed of pieces of plate and bar stock. The labor alone on these

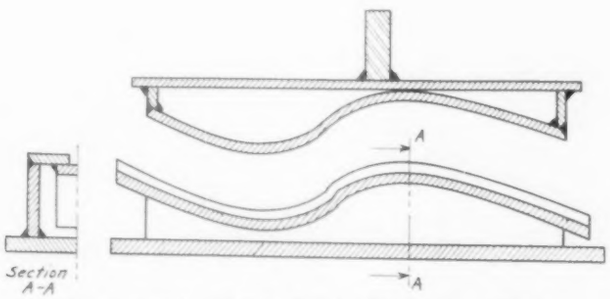


Fig. 4. Drawing of Tube-Forming Die Shown in Fig. 3.

drill jigs is less than the cost of a pattern for a similar casting. On the tail stock and index head, already described, the labor cost and pattern cost are practically the same.

Fig. 3 shows three examples of how electric welding is used in fabricating dies. The two pieces shown in the left of the view are a tube-forming die, which is a very interesting example of special design for welding. Longitudinal sections of this die are shown in Fig. 4.

The shaper form consists of 1-in. boiler plate for the base, all the rest of the material being cut from ⅝-in. plate. The punch and punch holder are of ¾-in. and ⅜-in. boiler plate, and the shank on the punch holder is a piece of 1¼-in. standard pipe. The cost of this die is estimated to be one-third that of a cast die. It will be noticed in Fig. 4 that the

plates between which the piece of tubing is formed are bent to the shape of the finished tube and then welded.

The other two dies shown in Fig. 3 are a flat-shearing die and an angle shearing die, the latter being on the extreme end of the bench. The die shoe and punch holder of the flat shearing die are constructed of 1-in. boiler plate, with a shank of 1⅝-in. cold-rolled steel, all parts being arc welded.

The angle shearing die was constructed by welding together several pieces of 1-in. plate, while the shank is of cold-rolled steel.

WELDING AND REINFORCING TANKS

Two interesting examples of tank-welding jobs done in the plant of the Anchor Welding Service, Inc., 4715 W. Chicago Ave., Chicago, Ill., are shown in the illustrations.

Welded Annealing Pot, and Close-Up of Weld.

Fig. 1 is an annealing pot that was brought in for repair. Although this pot contains 131 rivets, the seams also were welded, but trouble had been experienced with cracks around the rivet heads and with the weld on the longitudinal seam opening up. To correct this difficulty, two heavy

Oil-Storage Tank with Welded Seams.

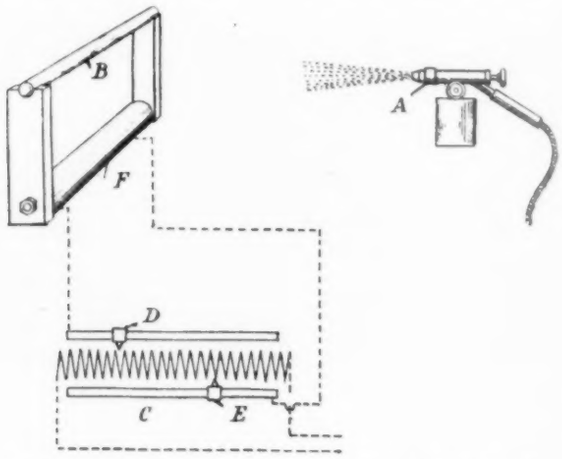
beads were laid along all seams by the arc-welding process and the rivet heads were reinforced with welds.

This pot is 51 in. high and 50 in. in diameter. The dished bottom is made of ¾-in. steel and the shell of ⅝-in. steel. Around the top of the pot is riveted and welded a ¾x4x4-in. angle, the outer web of which is reinforced with a ring formed from a 1x3-in. steel strip rolled on its edge. This ring is arc welded to the outer flange of the angle along both its edges.

Fig. 2 is an illustration of an oil-storage tank 6 ft. 6 in. long, 5 ft. in diameter, and ⅜ in. thick. The heads are flanged and dished and arc welded inside and out, the welder working through a manhole in the top to lay the inside beads. Welded to the tank are two 2-in. flanges and one ¾-in. flange, which do not show in the illustration.

MAGNETIC TESTING DEVICE

A novel device for detecting cracks in steel parts by magnetism is described in *The Engineer* of May 16, 1930, as British Patent No. 327,603. By the use of this invention, cracks are detected in steel parts by passing a magnetic flux through the part to be tested, so that magnetic polarity is formed across the edges of any crack that may exist. Iron powder is then sprayed over the part under test by means of a spray gun *A*, operated by compressed air, the part *B* under test being magnetized from a suitable current supply controlled by a potentiometer *C*. When the contact points *D*



Arrangement of Circuit and Apparatus for Detecting Cracks.

and *E* are moved away from each other in opposite directions, a potential difference is applied to the magnetizing coil *F*. Upon the return of the sliding contacts to the central position current ceases to flow in the coil, but there will be residual magnetism in the part under test and this would prevent the removal of the iron powder. If, however, the contacts are carried slightly past the central position a small current is caused to flow in the opposite direction through the coil *F*, which serves to remove the residual magnetism. The iron powder ejected from the pistol will adhere to any crack across which magnetic polarity exists.

WELDED BOILER WITHSTANDS EIGHT TIMES WORKING PRESSURE

The strength of welded boilers was demonstrated recently at the plant of the Hedges-Walsh-Widener Co., of Chattanooga, Tenn. The demonstration was held during the convention of the National Board of Boiler and Pressure Vessel Inspectors. At the final session of the convention, A. J. Moses, engineer for the Hedges-Walsh-Widener Co., read a report of the demonstration, and in commenting on this report, C. O. Myers, secretary of the Board, stated that the attempt to blow up the welded boiler made a very strong impression on the inspectors who always have insisted on riveted construction. The demonstration boiler was made to carry a pressure of 400 lb., and failed at a pressure of 3200 lb. The fact that the boiler did not fracture until after it carried a pressure eight times the pressure it was supposed to carry was a fine argument for welding.

Erecting the Ideal Piping Installation*

By Welding and Using Forged Radius Bends, the Piping System Becomes Virtually a Homogeneous Whole With Uniform Dimensions and Easy Curves

By W. P. Curley†

THE ideal piping installation is one of continuous true inside diameter and uniform wall thickness, or in other words a continuous tube of varying sizes as necessitated by design demand, unbroken by joints of any kind, anywhere in the system. While such an installation is entirely impossible, installations with welding and Tube-Turns have brought this ideal as close as possible, for with the work done by competent welders and under proper supervision it can be assumed that there are no joints in the welded line.

Tube-Turns are short radius fittings for the welded installation, made by forcing straight lengths of seamless tubing over a horn-shaped mandrel or die by hydraulic pressure at a forging temperature. The resulting product is unique in providing all of the following favorable features: Uniform thickness of wall, absolutely circular cross-section, perfect smoothness of surface, minimum possible bending radius, same weight per unit length as the pipe in the line, ease of assembling, and production of the bend to allow change in the direction of the pipe at any desired angle.

(*Above*) **Expansion Loops in Lakeside Hospital, Cleveland, Ohio.**

(*Below*) **Welding an Expansion Loop in a Supply Main in the Hillcrest Arms Apartment, Toledo, Ohio.**

One of the principal handicaps which the engineer specifying welding has had to contend with was the lack of proper fittings for making a change in direction in the completely welded job. Otherwise enthusiastic, in order to have an all-welded system, he has had to accept either long-radius pipe bends or mitered elbows.

Absorbing Expansion Stresses

It has become quite common for engineers and others interested in piping problems to associate long-radius bends with expansion ability. They are used in practically all cases for this purpose because of the inability of cast fittings, either screwed or flanged, to absorb expansion stresses.

Having had in the past no other alternative than the use of the same material as the pipe in the line to take up these stresses, engineers have, therefore, of necessity, designed long-radius pipe bends to the generally accepted standard of 5 times the pipe diameter, because bending pipe to a shorter radius by ordinary methods entails deformation of the pipe and fracturing of the metal.

Pipe bends are extremely stiff; the inside wall tends to buckle in bending and the outside wall is stretched. The question arises as to whether such a bend has as much ability to take up expansion and contraction as the corresponding lengths of straight pipe and Tube-Turns.

In the 1922 transactions of the American Society of Mechanical Engineers there appears an article on the "Elasticity of Pipe Bends" by Messrs. Crocker and Sanford, with an interesting discussion by J. A. Freiday giving valuable data on the advantages of expansion loops, made up with straight lengths of pipe and fittings, over the usual type of loop made with long-radius pipe bends.

Mr. Freiday and his associates had made an investigation some time previous to this discussion to determine the best method of providing expansion with the least reaction at the point of anchorage. The result of the investigation, he said, showed that loops corresponding to the expansion U-bends, but made up of straight pipe and fittings, produced less reaction than an expansion U-bend requiring the same space.

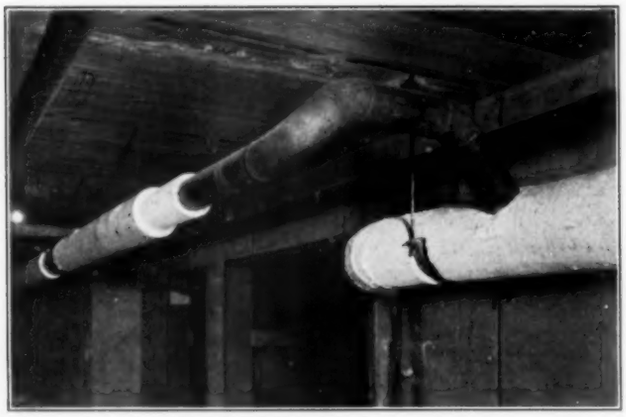
Using Tube-Turns and welding in place of the fittings described by Mr. Freiday, the resulting loop should be far

*From a paper presented before the American Welding Society meeting in New York City, April 25, 1930.

†Manager, New York District Office, Tube-Turns, Inc.

superior. The Tube-Turns are stronger than the pipe; and fittings, either cast iron or cast steel, are prone to structural flaws, especially when subjected to bending stresses as well as to high pressures and to temperature strains.

In addition to the design advantages and saving in space afforded by this type of loop, there is a decided saving in cost. Long-radius bends are awkward to handle. They are difficult to install when working in close quarters, and

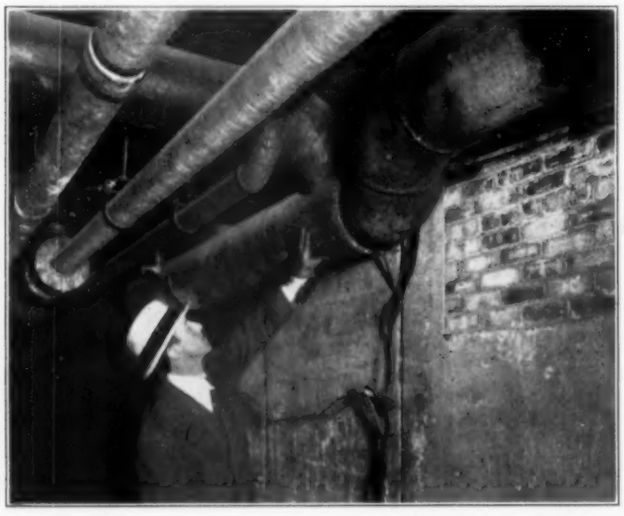


Joining of 6-In. Line With 12-In. High-Pressure Steam Line in Tunnel at New Plant of Chase Brass & Copper Co. in Cleveland, Ohio.

(One 6-in. 90-deg. and two 6-in. 45-deg. Tube-Turns are employed in making this connection. After this picture was taken, an additional 12-in. compressed-air main and two 6-in. supply and return 600-lb. hydraulic mains were laid through this tunnel and welded in their entirety.)

few contractors are equipped to bend any but small sizes either in their shops or in the field. Consequently bends are properly classed as "specials" with all that the name implies, in the way of high first cost, slow deliveries, and increased cost of handling on the job.

The stock Tube-Turns eliminate the necessity of having special bends made up in the fabricating shop and shipped long distances to the field. The contractor can make up



Radius Bends Are Used Not Only to Change Direction but to Act as Pipe Reducers in the New Cleveland Plant of the Chase Brass & Copper Co.

(The man's hand is touching a 14-in. pipe; above is a 10-in. take-off; and the two 45-deg. Tube-Turns at the right make an offset in this cooling-pond water line. A reduction in size of the line occurs at the butt weld a few inches to the right of the man's hand, the Tube-Turns and remaining line being of 12-in. size. Two 3-in. 90-deg. Tube-Turns are shown welded into a gas main at this point.)

his own expansion loops on the job, avoiding sometimes serious delays and showing very decided savings in freight charges and handling and erection costs.

Until the introduction of Tube-Turns, the use of various types of mitered elbows in place of flanged or screwed fittings was fairly widespread, although designing engineers were not always inclined to favor their use. This type of fitting is inconsistent with sound engineering practice, because of the resulting high-pressure drop. It makes a poor appearance, and its only recommendation was the necessity of its inclusion because of the lack of proper fitting for the 100% welded job. In short, it was and still is a makeshift; and because of resistance to flow, an efficient and satisfactory job can be secured only when the line is to operate under extremely low-pressure conditions.

Power Losses in Mitered Turns

To obtain some data on the comparative resistances of the various types of elbows, an apparatus was composed at Rice Institute by J. H. Pound, Professor of Mechanical Engineering, by arranging in series a steam turbine-driven

Tube-Turns and Straight Lengths of Pipe Were Welded at the Job Without Delay to Make These Three Offsets.

(These offsets are to be used on an underground steam line being installed by the Consolidated Gas & Electric Co., Baltimore, Md.)

centrifugal pump, a Venturi meter and four 90-deg. turns made by different methods. The four 90-deg. elbows selected for comparison consisted of a standard cast-iron screwed elbow and three welded turns. Only 3-in. standard pipe sizes were tested. In comparing the fittings for test, the welds were in all cases left just as they came from the welder. They were, however, good, smooth welds internally with no bad drips or icicles projecting inward. It was realized at the outset that the unavoidable variations in the welds themselves would prevent fixing for the friction loss across a given type of welded turn a figure which would be both exact and general. But the fact that the results would not hold exactly true for the products of every welder seemed no reason for failing to collect what data could be secured; and, since the aim of the test was to get an idea of actual field conditions, no special precautions to secure smooth internal surfaces were taken. Variable quality in welding would certainly shift the friction-loss curves up or down. How much this shift might be was not determined.

The tests indicate for all types of turn the typical hydraulic conditions of frictional loss increasing out of proportion to fluid velocity. One fact shown with striking clearness is that although the 90-deg. mitered fitting has only one welded joint between the piesometer connections as compared to the two welds needed in each of the two other welded types—a fact which favors it both in cost and to a certain extent in fluid friction—its sharp angles much more than neutralize this latter advantage. So far as

frictional resistance goes, it is by far the poorest of the turns examined. Professor Pound sums up his findings as follows:

"Power-bill savings can be applied against possible difference in first cost favoring the other turns against the cost of the installed Tube-Turn. In the case of a large installation, even small net savings per turn would total sums of real interest to the management."

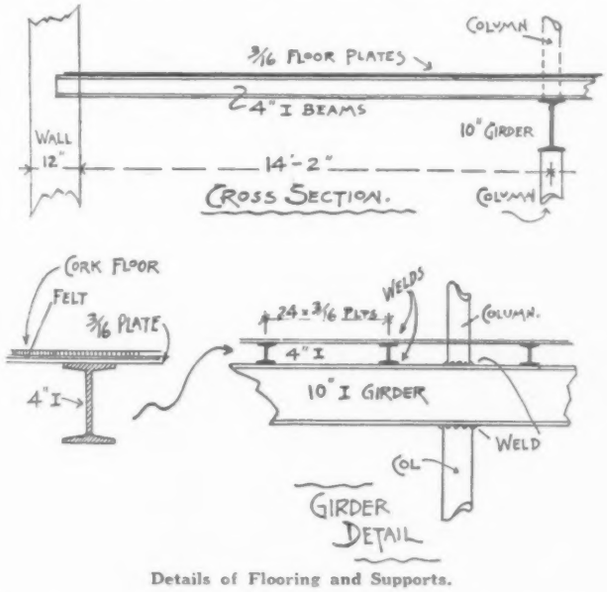
Lower Initial Expense for Radius Turns

In addition to an important saving in operating costs, Tube-Turns can show an additional saving in initial expenditures as against the built-up or mitered elbow, for one of the principal difficulties the welder has had to contend with is in fabricating the mitered elbow to obtain the desired changes of direction in the piping system.

When the skill of the man doing the work is limited, the utmost advantage necessarily cannot be derived from the process. Some welders, while adept at making their welds as strong as and often times stronger than the parent metal, have difficulty in fabricating special fittings cut to templet. It is not advisable, therefore, for a welder to undertake such exacting templet work, unless he has had considerable previous training, since only the more highly skilled artisan can successfully carry on this class of work.

FIRST WELDED STEEL FLOOR IN DENVER

Considerable interest has been aroused among contractors and engineers of Denver and vicinity by the use, for the first time in that district, of the "battleship deck" type of floor in the new office building of the Midwest Steel & Iron Works Co., at 25 Larimer St. The new addition is 28 ft. 4 in. wide by 90 ft. long on one side and 80 ft. long on

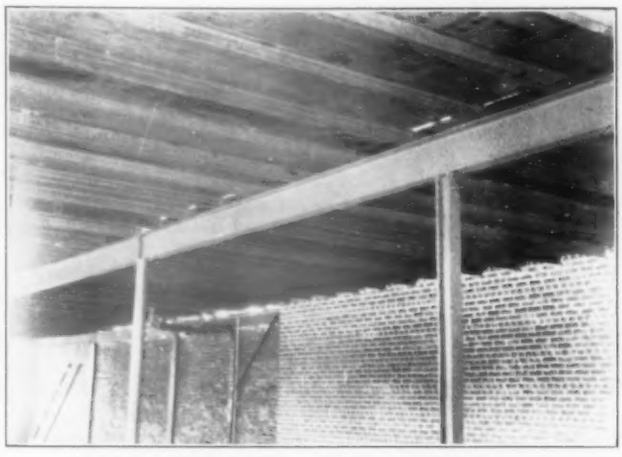


Details of Flooring and Supports.

the other, being built to conform to an angling branch of the Larimer viaduct, which it faces. It is of brick, two stories high.

The ground floor is of concrete, and the second floor of the arc-welded battledeck steel construction advocated by the American Institute of Steel Construction, Inc., and described in the January, 1930, issue of *The Welding Engineer*. Steel plates of $\frac{3}{16}$x24 in. were used, being spaced $\frac{1}{4}$ in. apart along the seams. The seams come over the center line of 2x4 in. steel I-beams used for joists. The edges of the sheets were tack welded to the I-beams about every 8 in., this procedure being found less productive of buckling than running a continuous bead. The open spaces in the joints were filled with plastic cement to make the surface smooth for floor surfacing. One of the illustrations shows the details of the floor construction.

The joists were set in the wall at each end, except where the new addition joined the old offices, about half way along one side. There both the second-floor and the roof construction is supported by columns and girders of 10-in. channels, with all-welded joints. In this part of the wall the edge of the battledeck plates between the I-beams is

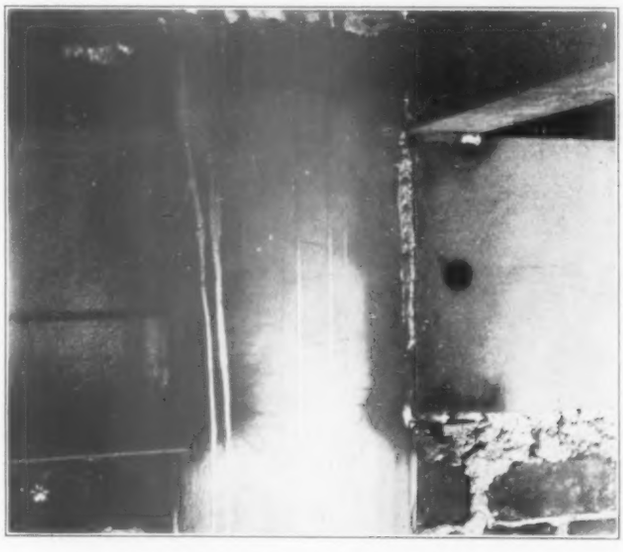


Battledeck Flooring as It Appears from Underneath.

(The steel plates are laid on 2x4-in. I-beams which rest on 10-in. girders supported by 4-in. columns. The I-beam joists are spaced 2 ft. apart and their ends rest on a 10-in. girder running along the top of the old wall, shown at the left rear, or are imbedded in the wall itself in the case of the new construction, shown at the right rear.)

stiffened by welding in short sections of formed channel between the girder and plates.

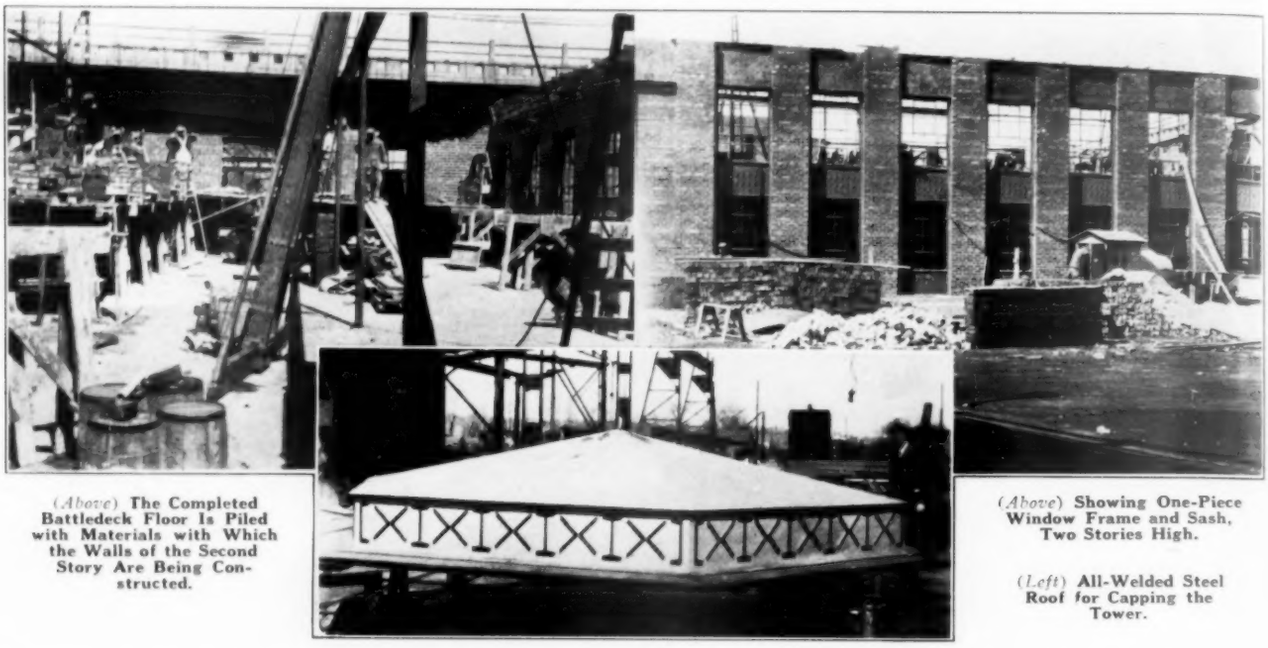
Through the middle of the building the 2x4-in. steel joists meet over the middle line of a 10-in. I-beam girder, set in the wall at each end and supported between by hollow steel columns 4 in. in diameter. These columns rest on



Detail of Column and Girders in the Section of Wall Adjoining the Old Building.

(The column and girders are 10-in. channels welded at their joints. A 2x4-in. I-beam joist is shown welded on the top of the girder to the right of the column.)

concrete footings and are welded to the girder. Similar columns on top of the girder support a like girder on which the roof joists rest. The ends of the girder beams are welded over the end of the columns, the flanges being stiffened by welding in a $\frac{1}{2}$-in. plate edgewise against the web joint. With a span of 14 ft. between the middle girder and the walls, a final test of the construction showed



(*Above*) **The Completed Battledeck Floor Is Piled with Materials with Which the Walls of the Second Story Are Being Constructed.**

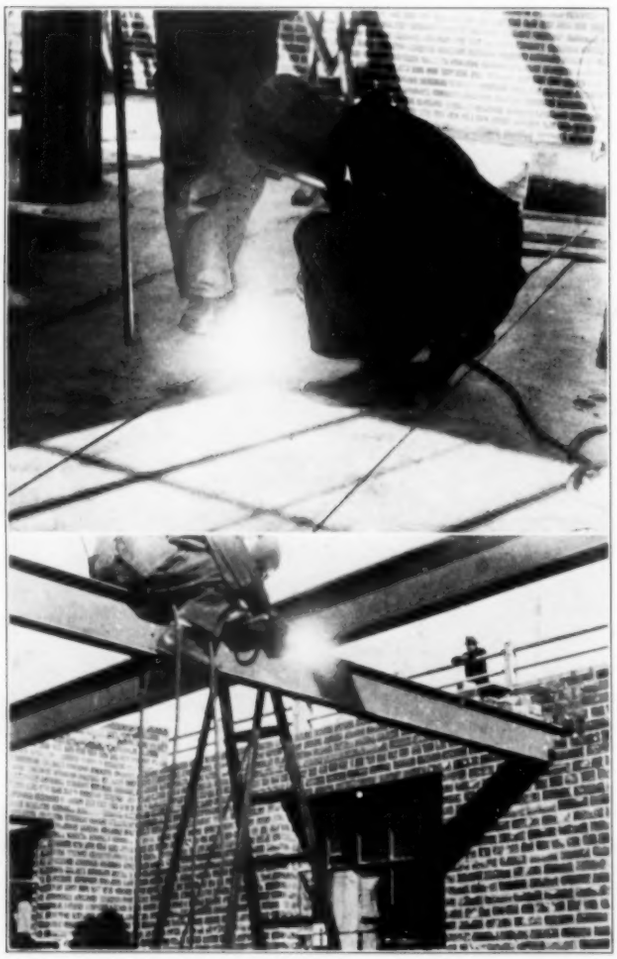
(*Above*) **Showing One-Piece Window Frame and Sash, Two Stories High.**

(*Left*) **All-Welded Steel Roof for Capping the Tower.**

a deflection of only ⅝ in. under a uniform load of 100 lb. per sq. ft.

The roof joists of the building were made by tack welding formed 10-in. channels of 10-gage metal back to back, welding the ends together and tack welding the joists to the top of the girder. At the front of the building, where a brick tower 18 ft. high and 16 ft. in diameter surmounts the roof, another battledeck floor 16 ft. in diameter was fabricated, using one 16-in. I-beam and several smaller ones, supported on steel columns from the ground floor. The ⅜-in. steel plates in this construction were stiffened by welding 2x4-in. angles to the under side between the joists. An all-welded metal roof structure, with ornamental steel work, illustrative of the company's activities, attached to the sides, was used on the tower.

(*Top View*) **Welding the Floor Plates.**
(*Bottom View*) **Applying the Electric Arc to the Roof Supports.**



All-steel window frames and sash, constructed in one piece, were used in both the walls of the building and in the tower. In the main walls these are 4 ft. 9 in. by 20 ft. 1 in., serving both the first and second story. They were raised and guyed in place before the brick piers were constructed between. These piers are 17 in. by 37 in. in size. Twisted steel rod of 1½-in. size was tack welded in the corners for decorative moulding. The walls of the building are 12 in. thick, except between the window openings.

The procedure followed in welding practically all the battledeck steel plates was to tack two seams at the same time, keeping the work in line. Early trials showed that continuous seams, or a single seam tacked clear across the building, tended to cause some buckling. With the method mentioned, however, a level surface was secured. A Westinghouse 10-hp. portable welder was used.

Roland L. Linder was the architect, and the C. E. Walker Construction Co., the general contractors. The steel work was by the Midwest Steel & Iron Works Co.

Invitations to examine the floor in course of construction were sent out by the Midwest Steel & Iron Works Co. to many engineers in the Denver district who would be interested. These invitations outlined the advantages of battledeck floor construction, such as its all-steel integral unit construction, reduced dead loads, greater economy in story heights, and a more exact and economical selection of column designs.

A. W. S. FALL MEETING RESERVATIONS

The Congress Hotel has been selected for the American Welding Society headquarters during its 1930 fall meeting of technical sessions, committee meetings and the fall dinner. Those who plan to attend are urged to make the Congress their personal headquarters during the convention.

The National Metal Exposition, to be held under the joint auspices of the American Society for Steel Treating and American Welding Society, will be at the Stevens Hotel from September 22-27. An attendance of from 50,000 to 100,000 is expected.

Economies in Welding Machine Parts*

Welded Chain Guards, Gears, Wheels, Levers and Other Parts Show Large Savings in Cost Over Riveted Construction or Castings

By J. H. Babcock†

THE process of welding—joining metals by heat—seems to be one in which all who use it set up their own standards to a more or less degree and weld their respective jobs in their own particular way. Standardization is not really in evidence.

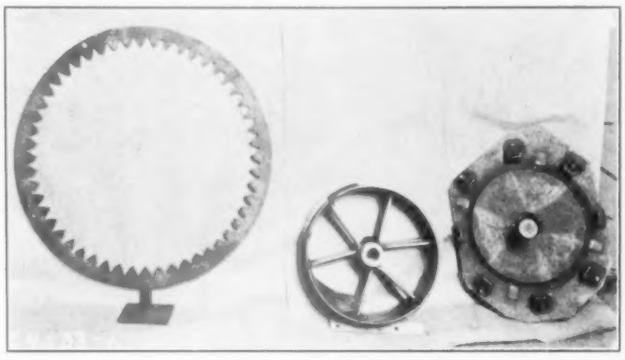
If different people engaged in different lines of work are willing to explain their own particular systems or operations, I think this would tend to have every one working in the same direction.

Five years ago an electric welder was placed in the shop to use, for what particular reason I did not know, although there was probably some motive behind the purchase of the machine. There was the machine and we had nothing to weld. It was up to me to use it for something, and with nothing designed for welding I set out to find something.

Welding Chain Guards Saves $664 per Year

At that particular time—and even today, for that matter—we were making a great many chain guards to put on our machines. They were more or less of a nuisance, employing many clip angles for fastening the strips and side plates together, so on one schedule of machines I omitted all the clip angles and left out the riveting holes and welded. By following the job up and watching the cost we found we had saved $16.44 on 15 chains, or a little more than one dollar on each. On one particular type of machine there are four chain guards of about the same design, so for the sake of brevity we will say that we saved one dollar on each guard or $4.00 per machine. That year we sold 166 of these machines, making a saving of $664.00 on that one type of machine alone. This one item almost paid for our original installation.

That type of work gave us our start, and since then we have been doing more and more welding, although we are not as serious or thorough on welding as we should be. I mean by that we haven't applied welding in all the places to which it is adaptable, but we intend to follow it up more closely in the future.



Left—**Welded Internal Gear Constructed With an 84% Saving in Cost Over Cast Gear of Same Strength.**
Right—**Welded Castor Wheel, With Jig, Representing 45% Saving in Cost Over Cast Wheel.**

We haven't done anything with welding on our structural chassis frames, but expect to in the very near future because we realize that with welded construction must come the same economy we have experienced in other lines.

Welding, besides saving money, is a manufacturing necessity. Without it many jobs now being done could not be accomplished. I have in mind several jobs in our own plant that could not be made in any other manner. Other jobs would require expensive and questionable castings and some would require roundabout structural methods and shapes to accomplish the same end that is now attained by a simple job of welding.

Welding Eliminates Much Detailing

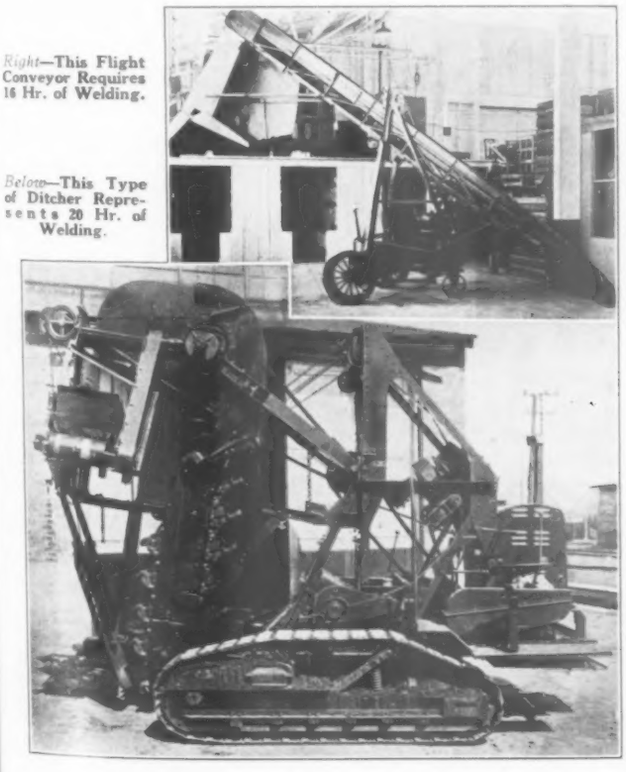
Welding, besides being a necessity, is in itself a synonym of economy. Any Engineering Department which is at all welding minded must realize that welded construction means economy in design. If you can take four or five pieces of steel of simple design and place them together and weld them, it obviously eliminates a great deal of painstaking and time-taking detailing in the Engineering Department.

For example, take practically any chain guard; instead of taking the side plates, detailing holes all around the edge and on the radii, on the center strip, and detailing clip angles to rivet these together, all that is necessary is to lay out the shape of the side plates, find the length of the center strip, roll to fit and weld.

This economy of detailing of a simple chain guard follows throughout the entire making and fabrication of the piece. It eliminates the duplication of the draftsmen's labor in the shop where the templets are made. It eliminates the marking of all rivet holes on these parts and the punching

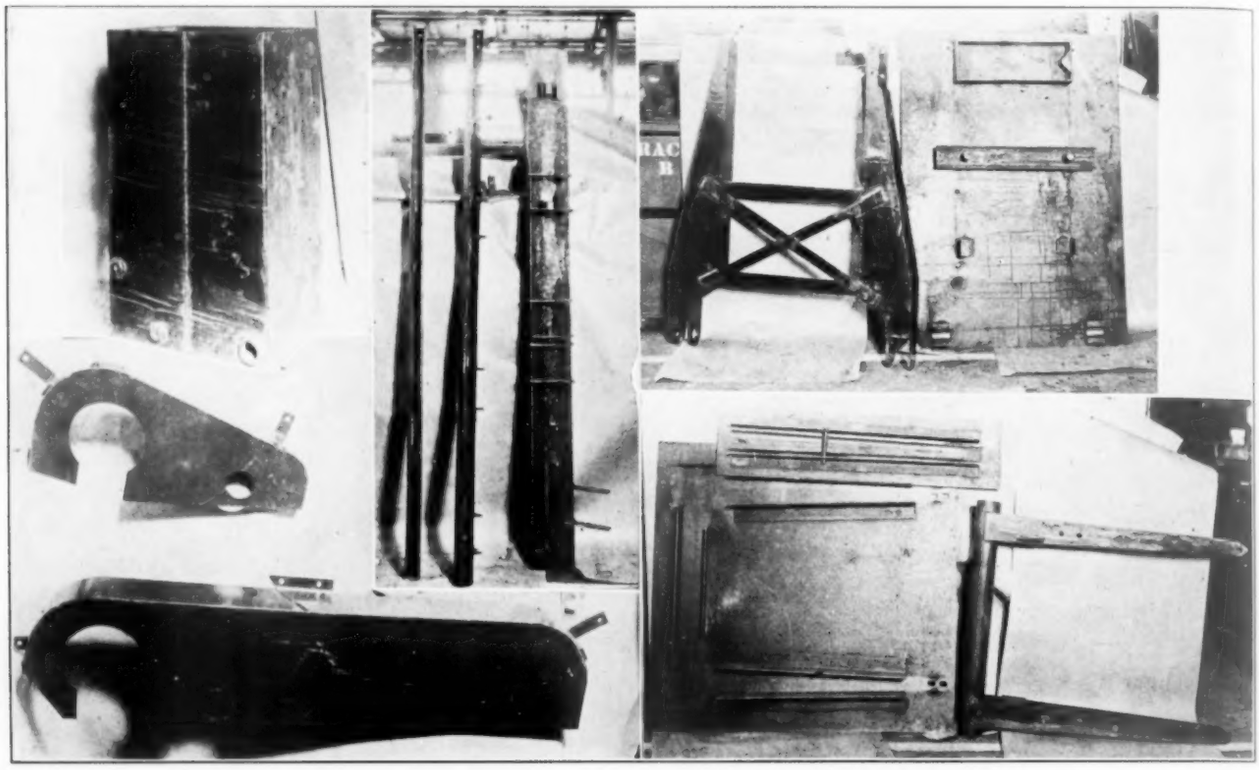
*Abstracted from talk given before the Chicago Section, American Welding Society, April 3, 1930.

†General Foreman, Barber-Greene Co., Aurora, Ill.



Right—**This Flight Conveyor Requires 16 Hr. of Welding.**

Below—**This Type of Ditcher Represents 20 Hr. of Welding.**



Upper Left—**30-Gal. Welded Gasoline Tank.**

(55% saving over cost of tank with galvanized riveted and soldered construction; also withstands vibration better.)

Center—**Welded Trunnion Guide.**

(Long channel-shaped item costs 42% more than casting, but has greater strength and accuracy. Welded shape much cheaper than pressed steel made outside.)

Upper Right—**Welded Push Arm and Jig.**

(U-shaped part with cross braces. 30% saving over riveted construction with castings.)

Lower Left—**Chain Guards.**

(Short one, 64% saving; long one, 80% saving over riveted construction.)

Lower Right—**Welded Pivot Yoke and Jig.**

(Large U-shaped part. Saving of 61% over steel castings.)

of the rivet holes, besides eliminating the making of all the clip angles necessary to put this chain guard together.

In fabrication, a few welds eliminate the grief of hand riveting, drifting of holes, and misuse of the steel in general to complete the job.

Welded Trusses for Conveyor.

(Designed for long spans. 12% increase in cost over riveted construction, but twice as strong as riveted truss. 40,000 lb. bending moment at 20 ft.)

What applies to the simple chain guard applies to welded construction in general.

While the economy of welding shows up to distinct advantage in steel construction in various ways, it has been our experience that the highest percentage of economy is evident in the replacement of castings by welding.

Economy of Welded Constructions Over Castings

In our line we have many odd-shaped castings and units made up of castings with structural parts. The castings must necessarily be made of steel to withstand the tension and torsion which our machines must endure.

While castings are all right in their place, I do not believe castings should be placed under extreme stresses, on account of failures which can be caused by blow holes, internal stresses, warps, and what not which are present to a more or less degree in castings regardless of

Left—**Stellited Hot Trimming Die That Trimmed 75,000 Forgings of Alloy Steel.**

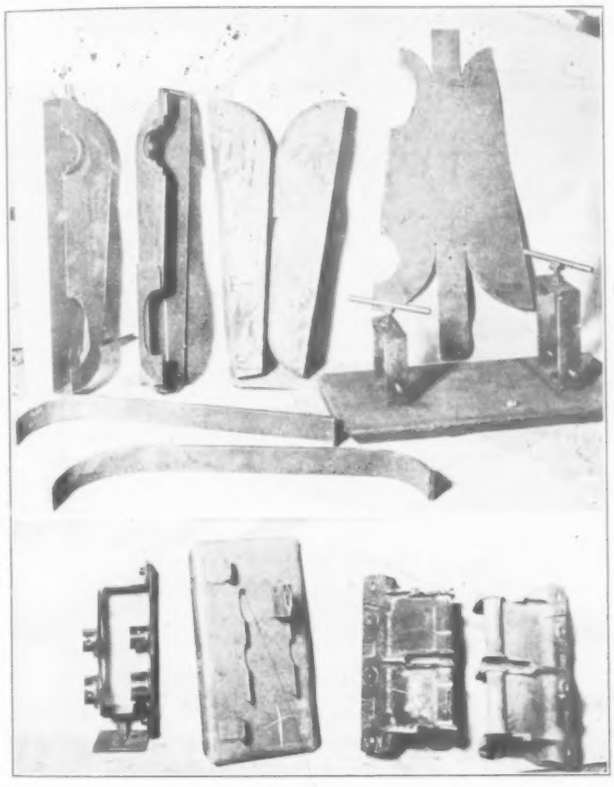
Right—**These Ditcher Teeth With Stellited Cutting Edge Have Five Times the Life of Ordinary Teeth.**

the care used in their manufacture, especially castings of peculiar shapes.

Castings, besides being expensive when they fail, are expensive in themselves, especially steel castings which run from 7 or 8 cents to 30 and 35 cents per lb. They are expensive at the very outset due to the engineering required. They are expensive in the pattern shop, the costs of which include expense, direct labor, and lumber for the patterns, core-boxes, and all the equipment that various foundries require, and after that comes the expense of maintenance of the pattern. Steel castings, as I said before, were expensive in their price per pound, and it is also necessary to pay freight and trucking charges and after that they must be inspected and machined. Many castings are faulty due to

blow holes, short hubs, shifted cores and bosses, and general inaccuracy. Thanks to the welder, many of these are saved.

We have a good example of reclaimed castings. One kind weighed 64 lb. and cost $7.20 each. One core had shifted, resulting in a corner being out of square, and as a consequence the casting was useless. By laying a bead along the edge and grinding square, the casting was saved. Of course, these castings could have been sent back to the foundry and proper adjustments made, but by welding and grinding considerable handling expense and freight were saved, besides eliminating friction that might occur between the parties concerned, and at the same time allowing us to use the castings when we needed them.



Upper—**Oil-Tight Drive-Chain Guard.**
(Shows design and method of welding. 35% saving with this type of fixture and welding jig over old method of tacking and welding without jig. Must be weather proof, hence accuracy is necessary.)
Lower Left—**Conveyor Hoist.**
(One bent and one straight bar with pipe bosses welded on. 75% saving over estimated cost of steel casting.)
Lower Right—**Ditcher Bucket Faced With Stoodite.**
(These have five times the life of regular teeth.)

Perhaps you have noticed that welders seem to be standard equipment in most foundries. If welding is substituted wherever it is possible, most of the expense connected with castings is eliminated.

I don't want to be misunderstood in what I have to say about castings. I don't mean that you can take any casting and duplicate it with welded construction with a saving. The point I want to bring out is that if you have a casting that runs to excess in cost and is in a position to receive severe stress or to cause trouble by inaccuracy, that is the part to duplicate. Castings of simple section and heavy construction are ideal for duplication.

Proper fixtures for welding greatly increase the percentage of saving and the accuracy of the parts or units fabricated. The illustrations show a few examples of where welding and proper fixtures have saved money and have increased accuracy.

Consider the Welder Himself

One of the biggest factors in welding economy is the comfort of the operator. Give him a well-ventilated place to work, good equipment and good material and rods to work with. We help our operators all we can in these various ways and also by giving them the best of service.

We actually serve our men with work. The material for each job is made ready before the welder finishes the job he is on. The jig is brought to his bench and the work plainly marked and a blueprint furnished showing how it goes together, and the finished job taken away from his welding booth. All he has to do is put his material on the jig, and sometimes we do that for him.

All this service not only eliminates the nuisance of hunting up material, jigs, etc., but reduces the cost by eliminating this lost time and also increases the welding capacity per hour, which is most important when capacity is limited.

There are many phases to this subject of economy and I have touched on only a few, but along with the economy and necessity of welding comes what I think can be called "standardization." I mean by standardization what others may call procedure control, or a definite effort to know just what is accomplished when a weld is made. In other words, if you do not use a high enough factor of safety for your weld you are liable to have some failures, because as yet no weld can be tested for actual strength unless the test is destructive in character. Good-looking beads do not mean strength.

Perhaps some of you read in the *Iron Age* of January the article on examination of welds. The tests made with kerosene under small pressure brought out the fact that a porous weld was not necessarily a weak weld, some testing 7,000 lb. per lineal inch. Some that did not show porosity were weak welds; 12 of 16 welds low in actual strength were non-porous in the kerosene test, which proves that porosity does not mean that a weld is weak.

Bucket Loading Machine, Requiring About 12 Hr. of Welding.

In a sound test five samples, rated very clear, tested 7,110 lb. per lineal inch; and nine samples, rated dull, tested 7,140 lb. per lineal inch, which showed that sound tests do not indicate the strength of a weld.

In visual inspection made by welders with five to ten years' experience the percentage of error was very high, ranging from 45% to 90% and giving the wrong grading on various samples. Such inspection is erratic to a very high degree.

I don't mean that good welds aren't made, because you are making them or seeing them made every day; what I do mean is that we don't always know exactly what we accomplish when we make a weld.

The best and safest way is to put on plenty of weld metal with an oscillating motion and also make sure that part of the crater shows up in both of the pieces welded together. The human element is a big factor in good welds and a man who doesn't like his job of welding will not take the care necessary, and does not belong on the job.

The Problem of Warpage

Another thing which nearly every one has to contend with is warpage or contraction of the weld on cooling, which tends to distort the finished piece. To some kinds of work this doesn't mean much because you have enough tolerance on heavy sections to forget it altogether, but in work that must be held very close to dimensions this will cause trouble. We have encountered this problem and it causes us trouble, but we do all we can to eliminate it by proper tooling and jigging to hold the parts rigidly to shape until the welds are cool, although many jobs have to be straightened or sized afterwards.

Any unit that requires mechanical accuracy should be machined after welding, such as a gear box or any article with bearings or shaft holes. The greatest part of these faults can be overcome by proper jigs and supports to hold the work to shape.

In boosting welding, I had to tell a little of the other side. However, the good side overshadows the bad side to such an extent that the bad side requires but minor consideration.

Altogether, welding when applied with proper thought will prove to accomplish more than ordinary results from the standpoint of economy, simplicity of design, and strength.

EVERYBODY'S BUSINESS

(*Concluded from page* 33)

uncontrolled din, it is not surprising that the nation is responding as never before to the call to provide the public with a reasonable degree of privacy from sound. People dare not enter a man's home or peep into it, yet he has no way of preventing them from filling his house with nerve-racking noise.

Research and experimentation have proved that the abolishment of a great deal of needless din is not only possible, but may turn out to be an investment yielding a gratifying return. Federal engineers have made progress in developing airplane cabins that will shut out considerable of the noise caused by propellers and engines, thereby permitting passengers to travel in greater comfort. In one plane that was given a quieting treatment, the noise in the cabin was reduced to the level of that in a Pullman car traveling on the railroad. Speaking could be carried on in ordinary conversational tones up to a distance of seven feet.

About 80 per cent of the noise on busy street corners in Chicago and New York is caused by automobile trucks, elevated railways, and surface electric cars. One study disclosed that the noise from horse-drawn or automotive vehicles could be reduced 50 per cent by merely creating a simple regulation denying the streets to any vehicle having loose or rattling parts. Such a regulation would save money, for it would prevent costly repairs later and lengthen the lives of vehicles. Gears that are properly designed and oiled make but little noise and suffer only a minimum of wear. Tests have indicated that a loose, badly serviced truck emits five times the noise of a truck that is well conditioned.

Other regulations should prohibit loudspeakers blaring into the streets, useless tooting of automobile horns, the excessive use of the sirens of fire engines responding to calls at night, the rough handling of ash cans and the employment of cow bells and screeching horns by junk wagons and fish peddlers. An actual census of automobile toots on a New York street corner recently showed that 97 per cent were wholly unnecssary. People walking the streets would not dare shout at each other in the same ill-mannered way they do when seated safely in a motor car.

Clever silencing devices are now being manufactured and supplied in hundreds of places to capture noise at the point of origin. The same principle once used in silencing the sounds of firearms is now being employed to do away with the noises from gas and steam engines, pressure blowers, vacuum pumps, valves, air hoists and hundreds of other types of machinery. On a quiet night an ordinary engine exhaust can be heard at a distance of four miles. Equipped with a silencer, the same engine under the same conditions, cannot be heard 50 yards away.

Silencing devices are made weighing from one pound to 20,000 pounds. The smallest silencer is three and one-half inches in diameter and two and one-half inches long. The largest silencer so far produced is nine feet in diameter and fifteen feet long.

Wherever brains are supposed to be active, noise costs money. It is for this reason that everyone should make a careful survey of his own business to determine if an investment in noise elimination will not pay a big return. We have good roads, good food, good transportation and many other good things because we are convinced that having them is profitable. Likewise, in the case of noise, we are coming to understand that the development of a more quiet civilization will yield dividends in dollars and cents.

Noise always represents energy misdirected, and therefore is a fairly true index of executive efficiency. It breeds mental confusion, is often responsible for misunderstood orders, indicates wear and tear on things that should be preserved, and produces in people an overstimulation that tends to make the present race unduly, if not dangerously, nervous.

Of course, not all noises can be stopped immediately. In ever so many instances the elimination of din would render it necessary to alter existing systems and work great hardships upon business and industry. But we must recognize that hundreds of noise nuisances are now accepted without any economic justification.

It will not be long until the average citizen will regard noisy streets with as much disfavor as he now does those that lack sewers. Landlords and architects who design and build offices and dwellings that admit too much noise will be held as much at fault as those who now allow roofs to leak or gas to seep into the basement. Sound-absorbing measures and devices will be regarded as no less important than provisions for heat and water.

In office and factory, every machine from typewriter to drill will operate in comparative silence. Noise will be attacked from both the point of origin and the point of absorption. Silent workshops will have covering materials that will make these rooms "flat" or "dead," while in auditoriums, churches and theaters, the aim will be to preserve rather than eliminate resonance. These advances will accelerate office routine, conserve human energy, reduce costly mistakes and release the human body from its present use as a sound shock-absorber.

The United States has created many things that are the envy of the world. One of our next duties is to so reduce national din that we shall be able to say in truth that here within our borders are also the quietest cities in the world.

Gas Welding Heavy Plate*

Experience Gained in Previous Construction of Rotary Kilns Is Supplemented by Improvements in Procedure, and Results Point to Great Advantages in This Kind of Construction

By H. E. Rockefeller†

ALMOST seven years have passed since the first large oxy-acetylene welded kiln was constructed and put in operation. At that time, very little was known about welding as applied to the construction of large steel-plate vessels; and since the requirements of the customer called for three kilns, a decision was reached to weld one and rivet the other two.

The required capacity for the kilns indicated a shell 8 ft. in diameter and 125 ft. long, and the riveted design required a plate thickness of 5/8 in. In the welded kiln the same design was employed as with the riveted kiln, except that welded seams were specified to replace the riveted seams in the kiln shell. That the construction was satisfactory has been proved by the tests for alignment and concentricity that were made, which showed it to be more concentric and straighter than the riveted kiln, and the completely satisfactory service given by the kiln in over six years of operation.

The cost of this welded kiln was naturally considerably higher than the riveted kiln of like dimensions, since at the time riveting was a known and established practice for this construction, whereas welding of containers of this size was an absolutely new venture.

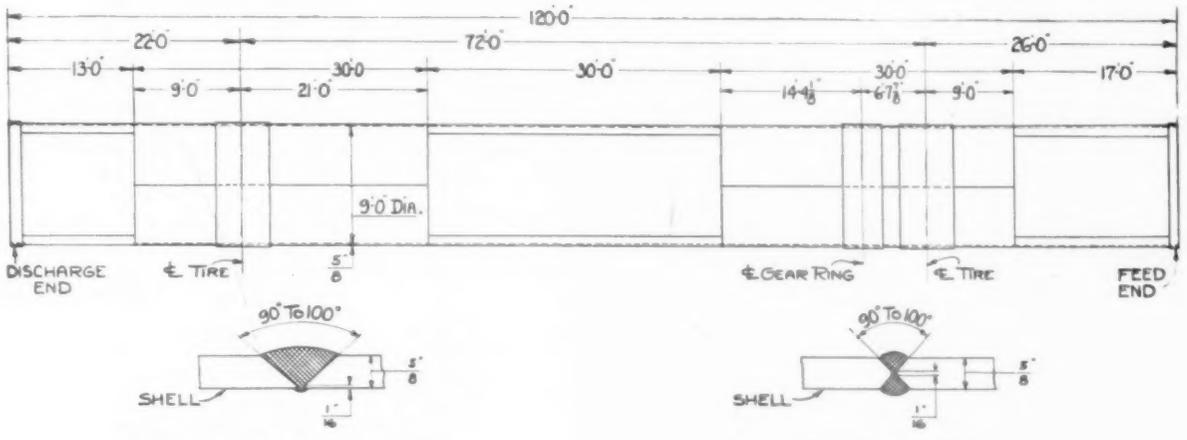
Past Experience Indicated Welded Construction

During the latter part of 1929, bids were issued by the same customer for two additional kilns 9 ft. in diameter by 120 ft. in length and 5/8-in. wall thickness. Alternate bids were requested on welded and riveted construction. During the intervening years since the date of construction of the first welded kiln, several steel-plate fabricators gained a vast experience in similar construction in the welding of hundreds of pressure vessels, some of which were comparable in size with the non-pressure rotary kiln then under consideration. Welding procedures had been developed and standardized, with a consequent reduction in the cost of fabrication. As was expected by those interested in the advancement of oxy-acetylene welding for this class of construction, the bids received on welded construction compared very favorably with those received for riveted construction, and the contract for both kilns was consequently let for welded construction.

It is not necessary to give any detailed account of the procedures followed in the construction of these two units, since the same procedure-control practices were followed in general as have been established for pressure-vessel construction. The following brief outline of the steps taken to meet the requirements of procedure control in this particular application will therefore, it is believed, be sufficient at this time:

Each of the welders was required to submit representative test specimens for tensile test. Four tensile specimens were cut from each plate submitted and on two of the specimens the reinforcement was removed. The average of the tensile tests of all the specimens covering the welds submitted by those who were approved, was 55,000 lb. per sq. in. Class A steel was used, having a minimum tensile strength of 54,000 lb. per sq. in. and a maximum carbon content of 0.20%. High-test welding rod was specified.

9'-0" × 120'-0" OXY-ACETYLENE WELDED ROTARY KILN.



LONGITUDINAL SEAM JOINT

GIRTH SEAM JOINT

Design Standards Followed

Single-vee welds with an included angle of 90 deg. and finish welded at the bottom of the vee were called for on longitudinal ceams, and double-vee welds for the girth seams. Ordinarily in steel-plate-vessel construction the longitudinal seams are subjected to the greater stress. In rotary kilns, however, the opposite is the case, as the stress to which the steel is subjected results not from internal pressure but from the load of the lining and contents, which causes the cylindrical shell to act as a beam supported at the tires.

The plates were laid out so as to provide for the minimum amount of welding and to remove the girth joints from the points of principal stress, which occur at the supports. The kilns being 120 ft. in length, five courses were used, the center courses being 30 ft. in length and the two end courses 13 ft. and 17 ft. The 13-ft. course was employed at the discharge end of the kiln because of the

*Paper presented at Annual Meeting, American Welding Society, New York, April 23, 1930.

†The Linde Air Products Co., New York, N. Y.

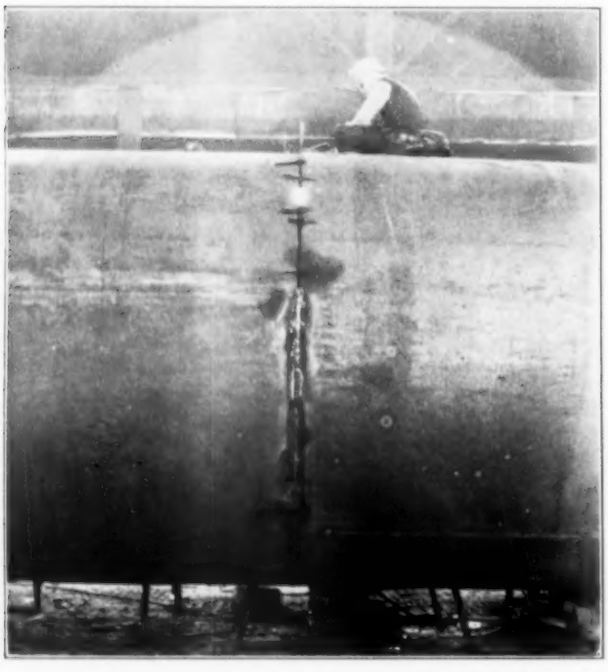
greater loading at this point than at the charging end. As the diameter of the kilns was 9 ft. three plates were used per course.

Preparation of Materials

In the fabrication of the kiln shells, the plates were first squared, beveled for welding on a plate planer, crimped along the longitudinal edges, and then rolled to the proper contour. In the two courses containing the tire and gear rings, the plates had to be punched for riveting, as the usual practice of riveting these connections to the shell was retained. The welding of the 30-foot. longitudinal seams was accomplished without any difficulty, as previous experience had definitely established that seams of any length may be entirely satisfactorily welded if the proper provision is made for the contraction of the seam during the welding. The 9-ft.-diameter girth seams were welded much in the same manner as in welding ordinary pipe, by proper equal spacing and tacking prior to the seam welding.

As stated previously, welding practices had been established very definitely for this class of welded-plate construction at the plant where these units were fabricated, and, as was expected, no delay or difficulty was encountered in the entire welded fabrication.

One unusual incident did occur during the fabrication, however, which bears mention. During the progress of the work, it was noted that in the 30-ft. section of each kiln containing the gear ring and one of the tire rings, the rivet holes had been laid out from incorrect center lines, which brought both of the above-mentioned attachments 5 ft. 4⅛ in. farther from the feed end of the kiln than specified on the drawings. If riveted construction had been employed for joining the girth seams, this entire 30-ft. course on both kilns would have had to be replaced, with a consequent large additional expense and considerable delay. The delay in this instance would probably have been in the neighborhood of four to five weeks, inasmuch as these plates would have had to be reordered from the mill and put through the necessary forming operations prior to the joining of the sections into the kiln shells. As the oxy-acetylene process was being employed in the construction of these units, however, it was necessary only to remove from the 17-ft. section the desired width, and to insert this section between two of the 38-ft. sections. The removal of the short section was accomplished by means of the oxy-acetylene cutting blowpipe, the cut edges being beveled for welding with pneumatic chipping tools. This section was then welded into the kiln shell in the same manner as the other sections and necessitated only one additional girth weld in each of the kilns.



Note Use of Wedge Clamps in Holding Girth Seam in Alignment.

Adopt New Practices

Another feature in the construction of these units, which had not been generally employed prior to this construction, was the rerolling of the courses after welding the longitudinal seams. This operation was carried out in a set of 30-ft. rolls without heating the plates before rerolling, with entirely satisfactory results. The rerolling of these sections both facilitated lining up the girth seams and aided in maintaining the straightness and concentricity of the shells.

Upon completion of the construction of the two kilns, measurements were taken to determine the concentricity at the feed and discharge ends, and the straightness of the overall length. The concentricity was determined by rotating the kilns on the tire rings. The straightness of the shell was measured by the use of a transit, measurements being taken at eight points along the kiln length at the quarter points of the circumference. The measurements for concentricity indicated that the kilns would rotate with an eccentricity of between ⅜ and ⅝ in. The transit measurements indicated that, as a cylindrical tube, the shells were within ⅝ in. of a true cylinder.

A New Step in Welding Heavy Cylindrical Sections—Rerolling a Course After Welding the Longitudinal Seam.

The several years of operation of the first welded kiln have proved the suitability of the welded joint for this construction. The recent completion of the two welded kilns just described is indicative of the present comparative cost of welded versus riveted construction. It would appear, therefore, that the process of construction which will be used in the future will be determined by the relative advantages of the two processes with respect to economic refinements in construction or savings incurred in operation.

As a basis for determining the present status and future possibilities of welding in this and similar applications, consideration must be given to some of the fundamental requirements of the kiln design and operations.

Since the kiln acts as a long beam overhanging its two supports, the stress in the shell at the ends will be zero, increasing gradually until it reaches a maximum at the supports. From the supports toward the center the stress decreases rapidly until the point of contraflexture is reached, and then increases to a maximum at the center of the middle span. At any one position of the kiln the stresses at the top of the shell and at the bottom are opposite in

value, but as the kiln rotates the stress at any point varies in magnitude from maximum tension to maximum compression for each rotation of the kiln. This continual changing load subjects the shell and joints to constantly alternating stresses and this factor must be taken into consideration, especially in the design of the girth joints.

Welding Gives High Strength

In order to meet this condition in riveted construction, the stresses must be kept unusually low. In the two riveted kilns constructed for the customer at the time the first kiln was welded, the maximum computed stress in the kiln was only 4,700 lb. per sq. in. under the worst possible condition of loading. The experience in riveted construction had shown that such a design stress was all that could be allowed for riveted construction, as otherwise trouble might be expected through the constant working of the rivets, resulting in their loosening and shearing off.

In order to check the design assumptions which had been established for riveted construction, a number of tests were conducted on the riveted kilns in service at one of the customer's plants after these kilns had been in service for a period of 2½ years. Measurements made across the triple-riveted butt straps in the girth joints showed movements from 2 to 2⅛ times the amount existing in the adjacent plates. This excesive movement was caused by the slipping of the sheets in and out each time the kiln was rotated. It cannot be said that this action was unexpected or unusual, as it has been observed in many other cases of riveted construction where alternate loading of the joints is a function of the operation. Under the worst loading condition, therefore, the actual stresses across the riveted joints instead of being theoretically in the neighborhood of 4,700 lb. per sq. in. would be in the neighborhood of 11,000 lb. per sq. in. It was, therefore, concluded that for riveted construction at least, the design assumptions were entirely logical, for if thinner plate had been used it could be expected that the kilns would quickly have worked themselves to pieces.

In the design of the first welded kiln and the other two which were recently completed, the same shell thickness was employed as would have been used for riveted construction. Since the welded kiln shell, however, acts as a single homogeneous cylinder, there are no concentrations of stress at the joints, and consequently the actual stresses in the welded kilns at the joints should check very closely with the computed stresses. That this is actually the case was determined from tests conducted on the first welded kiln at the time similar measurements were taken on the riveted kilns which were put in operation at the same time as the welded kiln.

Some engineers have hesitated to use welding where the joints are subjected to alternating stresses. The suitability of the oxy-acetylene-welded joint when subjected to such stresses has, however, been rather definitely demonstrated by the satisfactory operation of the first welded kiln for practically seven years, and should dispel any hesitancy on this score. It can be reasonably concluded, therefore, that for the same shell thickness a superior design will be obtained by the use of welded joints. It appears obvious, furthermore, where welding is used in place of riveting for the construction of kiln shells that the design assumptions may be altered to permit of a considerable reduction in the plate thickness. Even with a reduction of 25% in shell-plate thickness a greater factor of safety is maintained with the welded design than is secured with the usual design assumptions employed in riveted-kiln construction.

Reduced Operating Expense Apparent

Although to date advantage of this saving has not been realized in welded-kiln construction, the continued extensive use and better understanding of welding will certainly warrant its consideration. The reduction in shell thickness which can safely be employed by the use of welded construction will materially reduce the weight of the kiln shell and also decrease to a very large extent the cost of fabrication.

Even though the same plate thickness as would have been used if riveted construction had been specified, was employed in the last two welded kilns, a saving in weight of 21,600 lb. was effected through the elimination of the rivets and butt straps. This saving in weight represented 28% of the total estimated weight of the riveted kiln; and although it represents a small percentage of the weight of the kiln when fully loaded, it means that on the welded kilns the supports and driving mechanism are required to handle 21,600 lb. less weight.

A second consideration which affects the satisfactory operation of kilns is the straightness of the kiln shell as a cylinder, and the concentricity of the feed and discharge ends. A good many have the idea that where riveted construction is employed, concentricity and straightness may be assured if the plates are properly laid out for riveting and that, as far as welded construction is concerned, the distortion due to welding is likely to cause considerable eccentricity in welded containers. As a matter of fact, the straightness and concentricity of the kilns that were welded have been held within much closer limits than those which were riveted. Furthermore, after a number of years of operation, it has been determined that the eccentricity of the first welded kiln is only ¾ in., whereas on the two riveted kilns an eccentricity of 1⅛ and 2 in. has been indicated. Since, therefore, welded containers of this nature can be built straighter and more concentric than riveted containers, this factor should also augment the use of welded construction.

A third factor which is important in kiln construction is the smoothness of the interior of the kiln shell. Where riveted construction is employed this requirement necessitates the use of outside-butt-strap construction so that the only protrusions on the inside of the shell are the rivet heads. The necessity of this design for construction, of course, affects the efficiency of the riveted joints, as described above. In welded construction an absolutely smooth interior can be maintained, which gives a perfect surface for installing the lining.

Further Use of Welding Indicated

As indicated previously, the reinforcing plates, tires, and gears were designed and attached in the usual method employed in riveted construction. The expense in forming these attachments to the welded shell and their joining involved a considerable percentage of the total fabrication cost of the kilns. This construction, furthermore, has always given a certain amount of trouble in operation due to the length of the rivets which are required and the difficulty of maintaining a tight fit between the gear and tire rings and the shell. It appears obvious, therefore, as welded construction is more generally used, that the riveting of these attachments will be eliminated and that the tire and gear rings will be designed in such a manner that they can be directly butt welded into the shell and form a part of it. Special castings have been designed for use in welded construction to meet a similar need, and there appears to be no reason why a casting specially designed for welding would not very satisfactorily meet the required conditions for kiln construction.

In summing up the comparison of the economic considerations with respect to welded versus riveted construction of kilns and similar containers, there appears every reason to believe that the former construction is a logical one for such units. It is felt, therefore, that as these advantages are more fully appreciated, welding will be applied to the exclusion of riveting for such containers.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

REPAIRING A MILL SAW BY WELDING

By R. C. Liebe

Recent experiments have proved the welding torch a valuable tool in saw repairing, which bids fair to open up a great field for welding in the lumber world, where much saw steel is used and considerable monetary loss and delay are encountered owing to cracked saws and wrecks in the saw mills.

The illustration is that of a large mill circular saw which was badly wrecked by coming in contact with steel carriage dogs. The chalk marks show the extent of the breaks and cracks, these being enough to cause the saw to be considered a dead loss ordinarily and to be discarded for a new saw.

However, a shop undertook to weld the long 6-in. break indicated by the large arrow, and to weld in the points shown at the other arrows, these to be welded in place because of check cracks after straightening. After the edges of the long crack were V'd, this and the other breaks were welded successfully and without difficulty.

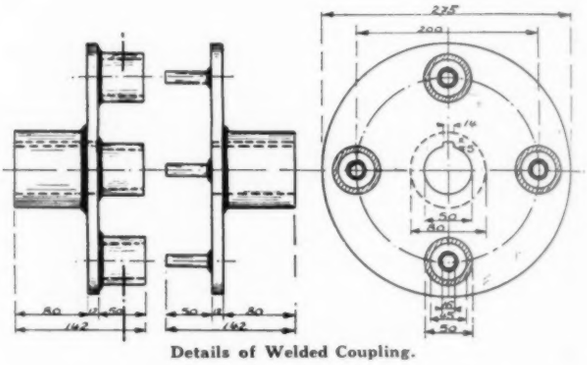
After dressing the welds, the saw seemed to be as good as new. Hammering was resorted to in order to relieve somewhat the stresses set up by expansion and contraction resulting from the welds. The dark line on the saw tooth shows the extent to which the tooth was built up by welding.

Showing Where Cracks Were Welded and Teeth Built Up.

These repairs cost less than one-tenth the price of a new saw; yet in the past large numbers of wrecked saws have been cast aside as worthless. Thus a new field is opened up for the use of the welding torch in the reclamation of saw steel. Mill owners are fast turning to the torch for repairing machinery breaks, and the use of welding for repairing saws will quickly follow.

MAKES FLEXIBLE COUPLING BY WELDING

A European shop, according to a story told by the Arcos Co., manufacturers of welding equipment, was called upon in an emergency case to supply a flexible coupling. Experiments were to be made with a converter on sudden notice and the coupling was needed for this purpose. A sketch was made in a few minutes, as shown in the illustration, and sent to the welding shop. The required steel plate, pipe ends, and rods had to be of such simple design that they could be cut quickly in the shop without requiring even the drilling of a single hole. The welding on of the various parts was done quickly. When the welding was completed, the two naves were turned, smoothed, and provided with grooves, which was the only precision work required. In assembling the coupling, rubber rings were placed upon the pins. This emergency call was thus quickly answered by a good welder and a good welding outfit, and the job was done reasonably.



Details of Welded Coupling.

INSTRUCTIONS FOR HYDROGEN WELDING

By C. J. Holslag,

Chief Engineer, Electric Arc Cutting & Welding Co.

The power leads having been connected to a power source of at least 100 amp. at 220 volts, the current and voltage studs are placed according to the character of the work. In general use heavy current for heavy work and light voltage for thin work. The welding leads are connected to the handle through the magnetic switch and foot switch. This handle contains a return circuit arrangement for the tungsten electrodes and a hydrogen tip, either adjacent to the electrodes or between them, with an adjustable valve so as to vary the quantity of hydrogen delivered, according to the requirements of the work. The tungsten rods are brittle and costly, so place them in position without the use of a hammer; and once in place, they are supported so as to be unbreakable. The supply of hydrogen being provided, we are now ready to start the arc. This is best done by the foot, elbow, or knee closing the contact switch. Before the arc is struck by the tungsten rods being brought together, the helmet, of course, is in place, so that the arc will not cause any injury to the eyes.

After the arc is struck the hydrogen flame should be adjusted so as to point the arc outward; then everything is ready to proceed exactly as in gas welding with exceptions as herein noted. The current and voltage to be used depend on the mass and thickness of the work approximately as a direct function. As before stated, the procedure is exactly the same as with gas welding except it is not advisable to use a filler rod fed in from the side by hand. It will be noticed that the metal can be heated to fusion just about as fast as the hand can guide the arc. Should it be desired to fill in with metal, it is better to let a wire be placed on the plate or strip between the two pieces to be fused than to try to feed the wire from the side as in gas welding.

There are three reasons for this: first, the work is done faster this way; second, the flame is too hot for hand working; and third, it is dangerous to have a third metal wire in an operator's hands where it could make a 300-volt contact. Of course the transformer is insulated, but it is doubtful whether you can handle 300 volts safely, even if it is insulated. The highest temperature known is in this hydrogen arc, and like all high-power tools it must be used with care. It only seems reasonable to state here that you must be careful with hydrogen, as it may explode. Hydrogen in the presence of oxygen or air forms one of the most violent gas combinations possible. Of course those operators who have had experience with oxygen and acetylene will be careful, but those who are not skilled had best be given considerable instruction.

The flame possesses characteristics that enlarge the scope of arc welding, because it introduces features which allow new work to be accomplished.

Speaking first of these new features: Tungsten can be welded; also molybdenum and chromium, which is practically impossible by any other method. The reason is that the molten metal is in an inert atmosphere of burning hydrogen and the air is kept away from the tungsten or molybdenum or chromium. The presence of air would oxidize these metals so that good fusion could not take place. The alloys of these metals can be welded readily by this hydrogen-flame process, and, of course, it is the alloys that are most useful industrially. The stainless chromium and nickel alloys also can be nicely welded by this process.

The ordinary boiling or oxidizing of these volatile metals is prevented in the hydrogen-flame process. This process is also useful for brazing either cast iron or copper or bronze. The same methods are here used as in gas welding. High-carbon alloys can also be welded, using the same procedure as in ordinary gas welding, without losing an undue amount of the carbon. Cast iron can be welded but preheating is very necessary. For this reason this process is not as useful as the metallic-arc or the ordinary gas process because of the heat and the necessity of handling both electric leads and gas hose.

It is possible to braze with the hydrogen welder; the oxide usually formed is quickly melted away by this process. By this method you can also weld brass, bronze, and copper. Although copper is normally nascent to hydrogen when hot, yet this flame imparts no noticeable amount of gas into the copper, so it is not hot or cold short after welding. Aluminum alloys containing copper, or pure aluminum, can be welded, the procedure being exactly the same as with gas welding.

The enemy of fusion welding is oxidization, or contact with the air. Oxides prevent fusion and cause grain slippage, imperfections, etc. The hydrogen-flame process prevents this and makes a considerably better weld.

The best feature of this type of welding is edgewise work; that is, welding together parallel edges, whether they be two, three, or four, or even more. This process is ideally adapted to such work whether on non-ferrous alloys or iron or steel. It is cheaper and nicer than any fusion method. We would suggest that you start with the two parallel edges. Then progress to laying the wire between two strips of metal so the three are joined.

The next easiest type is corner welding, which is like edgewise welding, except one edge is left protruding. The extra thickness of the metal is welded down to form a sealing bead. Butt welding should be left only to skilled welders, because the warping caused by the great heat involved causes confusion. No veeing out or preparation is necessary in skilled butt work, the arc being adjusted hot enough to melt away the edges as the weld is made.

Going back to the preliminary instructions of this article, when the burning hydrogen forces the arc outward, the correct volume of the hydrogen is shown by making a slight screeching sound, then the arc distance has to be adjusted to the speed of welding desired. A little trial will soon show the proper adjustment to be made between the welding current, electrode-tip distance, and hydrogen flow.

HASCROME USED TO HARD SURFACE WORN GEAR SPROCKETS

The current issue of *Oxy-Acetylene Tips* contains an interesting account of the use of hard surfacing which was discovered when a branch of the United States Post Office Department decided to overhaul some of the mail conveyor machinery in the main post office of a large city. The part of the machinery which had been subject to wear consisted of several large sprocket wheels over which ran a heavy link chain. This conveyor lifted great packages of mail from the lower levels of the railroad terminal to the sorting rooms on the upper floors. The inspection of the equipment showed that these sprockets were excessively worn by the friction of the heavy chain. The sprocket wheels being in good condition, except for the worn teeth, it was decided to save a part of the cost of replacement by building up the worn surfaces with a hard facing metal, and Hascrome was selected for the job. This is a self-hardening alloy manufactured by the Haynes Stellite Co. It is exceedingly hard and tough, and it is being used principally for building up worn parts which are to be surfaced with Haynes Stellite. It has been used successfully for hard facing some types of parts subjected to abrasive wear. It is supplied in the form of welding rod and may be applied by the oxy-acetylene process to steel or cast iron. In order to apply the Hascrome conveniently, the wheel was dismantled and divided into two parts. Two welders were employed to apply the hard facing material to a depth of about $\frac{5}{8}$ in. between the sprockets and on all worn parts. The entire wheel required approximately 100 lb. of Hascrome, and its use in this case saved a considerable amount for the Post Office Department. Since the wheel has been put back in service, it has shown no signs of wear.

MANGANESE TRACK WELDING

In the July issue of "Fusion Facts," published by the Stoody Company, Whittier, Calif., M. C. Smith has an interesting article which includes recommendations for procedure in the use of manganese welding rods for railroad work. The article states that when depositing with the electric arc, a current of approximately 120 amperes with a welding voltage of between 20 and 30 volts should be used. The bead is applied with the grain of the rail; that is, longitudinally along the length of the ball of the rail. Commencing on one side of the ball of the rail, a bead is applied with as little oscillation of the welding rod as possible, and laid the full length of the worn depression without breaking the arc, if this can be done. When the bead is finished, it is quenched and then peened. Quenching can be done with a bucket of water and a swab consisting of a rag attached to a stick. Such a swab will give the necessary quench without flooding the work with water. For peening, five or six blows along the length of the bead with a ball peen hammer are sufficient. The peening will loosen up the scale formed on top of the bead by the flux coating of the welding rod and will leave a bright and reasonably clean as well as smooth surface. The side of the bead—that portion of the rail to be covered next—should be gone over with a wire brush and then the next bead is applied parallel to the first. Each succeeding bead should be welded into the previous one about one-third of the width of the bead. A deposit made in this manner is said to require a minimum amount of grinding and should be free

from pin holes or surface checks. Sometimes there are copper connections or bonds between joints. In order to avoid carrying some copper across into the welded deposit, it is best to start the weld on the opposite side of the rail from the copper connections and finish with the last bead at the side of the connection. It is the practice of some roads to end each bead slightly under the length of the previous bead so as to obtain at the rolling on end of the deposited metal an angle of approximately 45 deg. across the rail. This method allows the rolling stock to roll upon the welded on portion gradually, rather than to hit it at one blow.

When applying the manganese rod with the oxy-acetylene torch, no attempt is made to lay it in beads, but the molten metal is puddled in and smoothed on over the surface in much the same manner as when hard facing material is deposited with the torch. After the molten metal cools and just as it turns black, it should be quenched in the same manner as indicated for arc deposited metal. It is not considered that peening is necessary when the deposit is made with the torch.

WELDED FIBRE-BOX-STEEL SPECIMENS SHOW HIGH STRENGTH AND DUCTILITY

A 40% elongation of the outer fibers of the weld is shown in some bend tests recently made of arc-welded specimens, and a tensile strength of more than 63,000 lb. per sq. in. indicated in pull tests. The material welded was plate

Welded Specimens Subjected to Tensile and Bend Tests.

of standard A.S.M.E. fire-box steel, 1¼ and 1½ in. in thickness, from which the specimens were cut and the welds ground off smooth to the surface of the plate before the tests were made.

In the case of plates of both thicknesses mentioned, a double-bevel joint was employed. The welds were made in the plant of the Lasker Boiler & Engineering Corp., 3201 S. Lincoln St., Chicago, Ill., and are denoted as "Lasker" welds.

"Lasker" welds are made with Fleetweld rod, a development of the Lincoln Electric Co., of Cleveland, Ohio, and reversed polarity is used. The amperage and voltage employed are higher than ordinarily, and the metal is caused to flow faster than in usual practice. Fleetweld is a flux-coated rod developed for rapid work and ductile welds.

The bend tests were carried out in the Lasker plant, and the tensile tests were conducted in the laboratory of the Armour Institute of Technology. In the former, the bend was made in the weld itself, at such a sharp angle as to reduce the inside radius virtually to zero. Evidence of fracture was encountered at the inside bend owing to the sharp angle of bend, but all these were shear fractures, and of small consequence. Measurement of the outer fibers of the weld before and after the bend tests indicated an elongation of these fibers of more than 40%, indicating a high degree of ductility of the weld metal.

The results of the tensile tests were as follows:

Number of specimen	1	2	3	4
Number of ⅛-in. holes	1	2	2	3
Width, in.	1.515	1.487	1.529	1.497
Thickness, in.	1.147	1.139	1.368	1.103
Gross area, sq. in.	1.738	1.694	2.091	1.650
Net area, sq. in.	1.147	1.408	1.750	1.237
Actual pull, lb.	90130	88190	94980	78760
Tensile stress (gross area), sq. in.	51900	52100	45400	47700
Tensile stress (net area), sq. in.	56500	62600	54300	63600
Where specimen broke	Outside weld	Outside weld	Outside weld	In weld

Specimen No. 4 actually had four holes drilled through the weld as the illustration shows, and this specimen broke because of its reduced cross-sectional area. One hole, however, in this specimen was drilled slightly off center, so only three holes were considered in computing the cross-sectional area of the weld at the point of fracture, although the line of fracture occurred through all four holes. Because of the location of the fourth hole, its effect on weakening the weld is unknown and hence was not taken into consideration.

It will be noted that specimen No. 4, which was the only one to fracture through the weld, showed a maximum tensile stress of 63,600 lb. per sq. in., whereas the highest tensile stress indicated for the parent metal was 52,100 lb. per sq. in., which was in the case of specimen No. 2. Hence the weld showed 22% greater strength than the best showing made by the parent metal itself.

BRINGS OUT 6-OZ. WELDING TORCH

A small, light-weight torch for aircraft welding and the welding of light-gage materials was recently developed by The Imperial Brass Mfg. Co., 522 S. Racine Ave., Chicago, Ill. This torch, known as No. 6X, has an overall length of 10 in. and weighs only 6 oz. It is easy to handle, fits

Light-Weight Torch for Aircraft and Thin Materials.

easily into small spaces, and can be held steady for long periods without tiring the operator. It is provided with five tips, numbered A1 to A5, which deliver an intensely hot flame. In those places where the heavier torches result in fatigue, to which can often be traced poor welds and warped tubing or sheets, the use of this torch should result in more uniform work and a saving of time and of gas.

DURONZE—A NEW "BRIDGEPORT" BRONZE

An alloy that is said to have the strength of high-carbon steel, the ductility of copper, and the endurance of fine bronze, has been developed by the Bridgeport Brass Co., Bridgeport, Conn., who is marketing it under the trade name "Duronze". This new alloy, which is described as a silicon bronze, does not become brittle upon severe cold working, as it is very ductile, and hence more mechanical operations can be performed on it with fewer annealings. In the annealed condition it has a minimum strength of 42,000 lb. per sq. in., but by cold working the metal into a wire ⅛ in. in diameter its strength is increased to 125,000 lb. per sq. in. Moreover, Duronze does not season or corrosion crack when exposed to weathering. It is highly resistant to chemical corrosion.

Duronze can be machined somewhat easier than phosphor bronze, it is claimed, and much more easily than many so-

called acid-resisting alloys. In threading, tools such as are designed for copper are suitable; and in stamping, forming or drawing, the same layout for tools as is designed on brass will work with equal satisfaction.

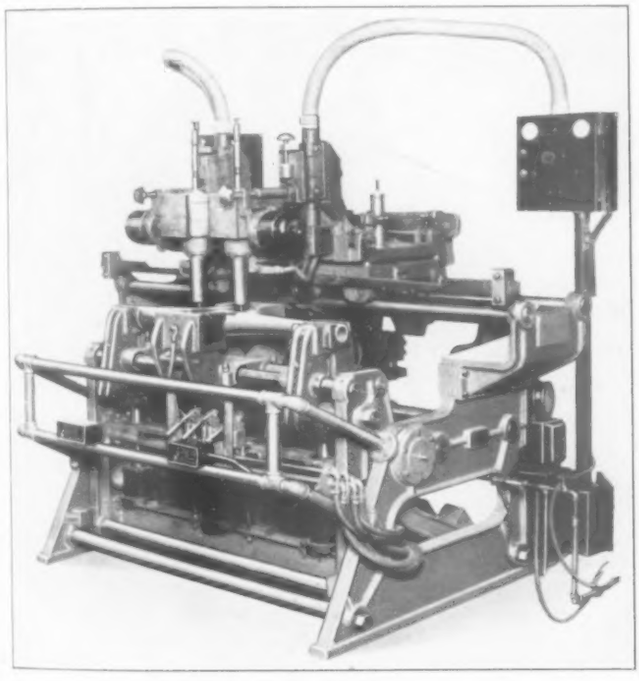
It is very uniform and dependable in its physical properties, and is available in sheet, strip, rod, and wire form. It can be hot and cold rolled, forged, formed, welded, brazed, soldered, cupped, drawn, machined, bent, buffed, plated, etc. It is recommended for many uses, including outside hardware and screws and nuts.

The physical properties of this alloy are listed in a booklet just issued by the manufacturer.

ARC WELDING REAR-AXLE HOUSINGS

A machine has been developed for the manufacture of rear-axle housings by the "Electronic Tornado" process of automatic carbon-arc welding. It consists of two automatic welding heads and clamps for holding the housings. The illustration shows the machine with the welding heads in the starting position.

As the housings, formed in two parts, come from the presses, they are placed in this machine to be welded. The jig which holds the housings is tilted down away from the welding heads toward the operator while the housings are being inserted. The jig is then swung back into position and the two arcs struck simultaneously. The welding heads



Machine for Welding Axle Housings.

travel across the seam, in opposite directions, fusing the metal together as they go. At the extreme end of the housing the heads strike a limit switch which automatically interrupts the arc and returns the heads to the original position, ready to repeat the cycle. The housing is then turned through 180 deg. and placed into position for welding the reverse side.

The welding current for this machine is furnished by "Stable Arc" welders manufactured by The Lincoln Electric Co., of Cleveland, Ohio. A 400-amp. welder furnishes the current for each separate head.

A leading automobile manufacturer states that these machines have produced six definite savings in his plant, as follows: Saves trimming of halves before welding; saves trimming flash after welding; saves broaching inside; saves press operation of coining the reinforcement; saves cleaning out flash on inside by hand; and saves stock.

The floor-to-floor production on this machine is about 25 housings per hour, the exact number depending on the size of the center opening. The housings are prepared for this machine by coining up the edges of the pressed halves. These coined edges throw up a lip which increases the thickness of the material along the edge to be welded.

TRUCK-MOUNTED WELDER WITH ENGINE DRIVE

The Clark Trucwelder is a completed mobile, self-contained, gas-powered, electric-arc-welding unit capable of 24 hours' continuous operation. It is equipped with self-starter and headlights, carries all necessary welding accessories, has ample room for oxygen and acetylene tanks for cutting, and seating room for crew, and the motive power is ample for towing trailers.

Welding current, ranging from 60 to 250 amp. at 25 volts, is developed by a self-excited G-E arc-welding generator

The Welder and the Truck Are Driven by the Same Engine.

with control, driven by a special heavy-duty 4-cylinder gas engine developing 20 hp. at 1,480 r.p.m. Currents between 25 and 60 amp. may be obtained by inserting in the circuit a current-reducing resistor provided for that special purpose. The current available is ample for use with commercial sizes of metallic electrodes from $\frac{1}{8}$ to $\frac{3}{16}$ in., also for light carbon welding or cutting.

Engine and generator are connected by an endless special-composition belt, 3 in. wide. The generator is thrown in and released by a hand-controlled belt tightener—a ball-bearing idler mounted on sliding ways, located on the driver's platform to the right of the driver.

Automatic stabilizing of the welding arc is provided by a self-adjusting reactor, making it easy for the operator to maintain a steady arc on low as well as high currents, under all welding conditions. For striking the arc, a high open-circuit voltage of 65 volts is available, after which the voltage is automatically reduced to that required to maintain the arc. Adjustments in the range of welding current, from 60 to 250 amp., are made by simply shifting the generator brushes by means of an external handle. Further adjustment down to 25 amp. is made by an easy shift of electrode leads.

The Trucwelder provides a convenient, reliable means of taking the welding equipment to the work. It reduces time and distance, eliminates waste time in moving from job to job, provides a high working capacity per unit, and thus makes possible a high output of work, which reduces the cost per weld. The Clark Tructractor Co., of Battle Creek, Mich., manufacturers of the Trucwelder, states that it conforms to the specifications of the U. S. Bureau of Standards, meets the requirements of the U. S. Navy Department for arc welders, and is listed as standard by the Underwriters' Laboratories.

WELCO SPOT WELDERS

Welded Products Corporation, 1625 Cleveland Ave., Kansas City, Mo., have published bulletins describing the Welco electric resistance spot welder. The type "G" 10 kilowatt machine is supplied in five sizes ranging in price from $385 to $465, with capacities from 22 to 14 gage at maximum speed. These machines have been designed especially for welding galvanized and coated metals. Other types have been designed for the welding of clean metal and are described in a considerable range of sizes and capacities.

METAL BOND PRODUCTS

A folder received from the Metal Bond Manufacturing Co., 4211 N. Broadway, St. Louis, Mo., describes an interesting line of soldering products. The Metal Bond tinning compound is made to give a permanent tinned surface on cast iron, steel, brass, bronze, copper, and galvanized iron. No acids are used in connection with this compound. Metal Bond aluminum solder is designed for soldering aluminum, both drawn and cast, and for soldering die cast metals. It can be used for repairing crank cases, cylinder heads and blocks, aluminum bodies, aluminum patterns, household utensils, etc. Metal Bond special body solder is made for use in repair of automobile bodies. The line includes fluxes for brazing, for cast iron welding and for aluminum welding, and a special compound for shape welding. There is also listed a special preparation for sealing porous spots in electric welds on water jackets and other cast iron parts or as a filler over rough welds. Included in the catalog are welding helmets, goggles, gas lighters, wire brushes and welding-rod holders.

ISSUES FOLDER ON HANSEN ARC WELDERS

A special commutator-pole winding to stabilize the arc, micrometer-screw adjustment of the welding current, and auxiliary brushes for self-excitation—all features of the "Hansen" arc welder—are described and illustrated in a folder recently issued by the Northwestern Manufacturing Co., 480 Clinton St., Milwaukee, Wis. Other features of design and operation are listed, and welders equipped with various types of power units and with different mountings are shown.

BOOKLET ON STRUCTURAL-STEEL WELDING

Development of structural joints, advantages of arc welding, tests and design, qualifications of welders, inspection, welding and building codes, and descriptions of buildings erected by arc welding, are among the information given in an illustrated 24-page booklet, known as bulletin GEA-1161, issued by the General Electric Co., Schnectady, N. Y. Examples and tables for computing stresses and designing welded joints are included. An appendix lists those cities allowing the arc welding of buildings and also those whose codes are being revised with welding under consideration. The shop that does a business in the welding of structural steel will find much valuable engineering information in this bulletin, as well as some forceful arguments for their sales department in the selling of welded structures.

NEW LINE OF ELECTRODES

A folder has been received from the Ketchbaw Engineering Service, 4518 Clarendon Avenue, Chicago, Ill., describing a new line of special arc welding electrodes. One of these is called Ketchbaw Arciron, which is a coated cast iron electrode. It is stated that this will produce a high-grade cast iron deposit without hard spots or porosity. The manufacturers state that the coating is applied only for the purpose of stabilizing the arc and that it does not have the effect of introducing any elements into the weld which might change the original qualities of the metal. Armourweld is the name of another electrode in this series which is a specially prepared coated electrode for hard facing and building up worn surfaces of parts which are subject to abrasion. It is stated that this deposit is not machineable but may be ground to any desired shape. A third electrode in the series is called Manganarc, which is described as a special alloy base suitably coated for use with the electric arc process in the reclamation of manganese alloys. It is stated that it is particularly adapted to building up worn surfaces which are subject to considerable shock in service. The folder gives complete instructions for the use of these various electrodes.

NEW CATALOGUE BY SUTTON-GARTEN

The Sutton-Garten Co., Indianapolis, Ind., have just issued a new welding equipment catalog. The new book is an unusually complete and well prepared catalog of welding equipment of all kinds. It describes and illustrates apparatus, parts and supplies for both gas and electric welding. In the supply items are included solders, fluxes, helmets, hand shields, goggles, electrode holders, cable, masts, respirators, torch lighters, wire brushes, pre-heating torches, trucks, sand blasting equipment, welding tables, grinders, welding jigs, welding hose, protective clothing, metal welding pots, and a number of other items. There is a complete line of welding rods and electrodes, including coated electrodes and non-ferrous welding materials. The catalog is printed on a good grade of paper in 8x10-in. size, and practically all the items listed in it are well illustrated. This is the sort of printed matter which helps the distributor of welding equipment and supplies to build business, as it makes the selection of various products easy for the prospective buyer.

The Sutton-Garten Co. is described as an organization of welding engineers and practical welders who have been specializing in this line of business for 15 years. They feature their free course of welding instruction which is offered to their customers, and point out that they are in a position to service and repair their equipment and to give expert technical advice to their customers.

ARC WELDING PLATES WITHOUT BEVELING

How successfully to arc weld mild-steel plates up to ⅝ in. in thickness, and even greater, without beveling the edges, is described in bulletin No. 6, recently issued by the Fusion Welding Corp., 10257 Torrence Ave., Chicago, Ill. The technique described is said to give thorough penetration with no sacrifice in strength. Instructions are given for flat, horizontal, and overhead welding. Various types of electrodes are recommended, depending on the position of the weld and the penetration desired. For high penetration, the Yellow Jacket electrode is recommended, and the operating technique for using this electrode is explained in detail.

Among the advantages claimed for this method of welding are the savings in time and labor made by eliminating preparation of the joint, and a reduction in the amount of electrode material required.

BOOKLET ON AUTOMATIC ARC WELDING

"Automatic Arc Welding by the Electronic Tornado Process" is the title of a very complete and attractive 40-page booklet, publication of which was recently announced by The Lincoln Electric Co., Cleveland, Ohio. This new booklet contains a host of valuable information on automatic welding with the carbon arc, and describes in detail the advantages of this process. Results of tests of strength and ductility are tabulated and fully described, as well as other tests which have been made by The Lincoln Electric Co. This booklet also shows the application of the "Electronic

Tornado" in various industries, and records in detail the speed and costs attained by using this method of manufacturing.

NEW AMICO CATALOG

Amico Novelty Co., 40 West 33rd St., New York City, have issued a new catalog describing their new improved round-file lighter. The frame is made of piano spring wire, cadium plated, and the imported file is made of glass-hard steel. Renewal tips are nickel-plated, packed a dozen to a box. Flints are individually packed, each in a glassine envelope; all are specially treated to resist powdering. A distinctive feature is that an advertisement will be imprinted on the lighter upon request.

GEORGE WATSON HEADS SALES DIVISION OF NEW SERVICE ORGANIZATION

The office of general sales manager in charge of sales and publicity of the Welding Engineering & Research Corp. has been tendered to George Watson, who resigned as sales manager of the Wickwire Spencer Steel Co. on May 15th to take up his duties with this new organization of engineers engaged in the solution of welding problems and in the advancement of the industry through publicity and research.

Mr. Watson's experience makes him peculiarly well fitted for his new duties. Following his graduation from the Sheffield Scientific School of Yale University, he donned overalls and worked for three years in the Spencer Wire Mills and then joined the sales force. His natural sales abilities becoming evident, he was put in charge of flat-wire sales and later handled all wire sales of the Spencer Wire Co.

George Watson.

In 1919, when the Spencer Wire Co. became a part of the Wickwire Spencer Steel Co., Mr. Watson was made assistant sales manager and later sales manager. He successfully handled not only tonnage sales, but directed the merchandising of special wire products.

Mr. Watson and his associates in the sales division of the Welding Engineering & Research Corp. will devote their time to advising and assisting subscribers to the company's service regarding the selling of welding, and will aid in establishing friendly commercial relations with industrial and public-utility companies. Mr. Watson's temporary address is 30 Church St., New York, N. Y., but as soon as the company's laboratories are completed in Long Island City he will take quarters there.

INCREASING SALES OF TUBE-TURNS REQUIRES ADDITIONS TO PLANT

Additions to the plant itself and in equipment which will increase the production of Tube-Turns, Inc., of Louisville, Ky., by 60% have been announced by Walter H. Girdler, president of the Girdler Corp., which operates the Tube-Turns company. Expansion of facilities has been made necessary by increased sales, said Mr. Girdler, who points out that sales for the first five months of 1930 were 271% more than for the corresponding period of last year. For some time the plant has been operating 24 hr. a day, six days a week. Construction of the addition to the factory has been completed and the new equipment will be ready for operation by August 1st, it is announced. Tube-Turns, Inc., has extended its markets to Hawaii, Canada, and Central and South America. There are at present 44 distributors in this and other countries.

CHASE OPENS NEW PITTSBURGH WAREHOUSE

A new warehouse at 855 North Ave., West Pittsburgh, Pa., built for the Chase Brass & Copper Co., was officially opened on July 14th, and will carry a complete stock of the company's brass and copper products, including welding rods. The store space and stock rooms in the new building are spacious and well equipped. This is the nineteenth of the company's warehouses spread out over the country from coast to coast.

CORRECTION

In a previous issue of *The Welding Engineer*, a news item regarding the new plant to be constructed by the Kansas City Oxygen Co., Kansas City, Mo., stated that this new plant would cost $50,000 with equipment. We are advised that this amount is an error, and that the initial investment will be $150,000, and that it is planned to increase this investment later.

TALKING PICTURE TELLS OF WIRE ROPE

One of the first successful "talkie" industrial motion pictures to be produced was recently released by the American Steel & Wire Co., a subsidiary of the United States Steel Corp.

In this "talkie," featuring a trip through the mills in which wire rope is made, the entire process becomes not only visible on the screen, but the illusion of actually being present is increased by the introduction of sound. As each stage of manufacture is viewed, it is orally explained in a detailed and impressive manner. In this way many important points of interest, impossible to cover in the usual screen captions, are conveyed to the listener.

An added and novel feature is the use of lively music at certain spots where the action does not require conversation. This combining of entertainment with educational factors has proved unusually effective in maintaining interest to the highest possible pitch.

Although the adaptation of sound to industrial films is new, the remarkable success of this venture foreshadows a widespread use, in the opinion of officials of the American Steel & Wire Co.

NEWS OF THE INDUSTRY

The Improved Steel Gas Engine Head Co. has leased buildings for a machine shop and welding shop at Tulsa, Okla., and will manufacture a special steel head for gas engines. The company is a subsidiary of the Sterling Steel Castings Co., East St. Louis, Ill. Roy Green is general manager and J. S. Newlon shop manager.

E. C. Frey, formerly manager and treasurer of the Harrisburg Pipe & Pipe Bending Co., Harrisburg, Pa., has organized the Frey Steel Products Co. for the manufacture and sale of channels, angles, and other light-weight sections.

The plant of the new company is at Milton, Pa., and the office at 620 Lewis Tower, Philadelphia, Pa. The Pearce Fireproof Co. is acting as distributor. Millard D. Meyers, who has been rolling sections for a number of years, both at Johnstown and Harrisburg, Pa., will have full charge of operations.

The Conley Plaster Machine Co., of Compton, Calif., is erecting a new plant and installing equipment and machinery for the manufacture of the first and only machine ever made for applying plaster in building-construction work. The new machine, which will have considerable welded construction, is designed for handling all kinds of plastering and stucco work, both interior and exterior, and is described as a revolutionary development. The plant was expected to be ready for operation July 1st. Mathew Wilson is president and H. A. Conley vice-president and general manager.

The Micro Products Co., of Peoria, Ill., has appointed the Allan Manufacturing & Welding Co., Inc., 726 Washington St., Buffalo, N. Y., as distributor of their line of electric butt welders for the states of New York, Connecticut, Massachusetts, Vermont, New Hampshire, Rhode Island, and New Jersey.

Henry Booth, sales manager of Shawinigan Products Corp., has been on an extensive business trip, visiting jobbers in Chicago and other points in the Middle West.

Parker B. Francis, secretary-treasurer of the Kansas City Oxygen Gas Co., 2012 Grand Ave., Kansas City, Mo., is making a two months' tour of the United States, during which he is combining business with pleasure.

The Prest-O-Lite Co., Inc., 30 East 42nd St., New York, N. Y., has placed in operation a new plant for the manufacture and distribution of dissolved acetylene, at 648 Bryan Stock Trail, Casper, Wyo. The purpose of this plant is to help meet the increasing demands in the use of the oxy-acetylene welding and cutting process in that region.

W. D. Patterson, president of the American School of Welding, 3031-33 Locust Blvd., St. Louis, Mo., reports a very interesting lecture on Tube-Turns and fittings, given recently before the students of the school, by A. W. Parker, of the Stewart Machinery Co., of St. Louis. Mr. Parker covered the subject very thoroughly and brought out some very good points in favor of using welded stock fittings instead of cast-iron fittings and flanges. According to Mr. Parker, some of the largest industrial plants in the St. Louis territory have standardized on Tube-Turns for pipe fittings.

M. H. Schober, of Alhambra, Calif., recently opened a welding and auto repair shop at 816 Date Ave., in that city. Mr. Schober, who formerly was associated with his brother in the operation of an air port near Alhambra, will feature welding, brazing, and general repair work in his new shop.

Sam Shelley, of San Diego, Calif., who owns and manages a welding shop and is also a pipe-line contractor, is erecting a new building and will soon move his plant to the new location at 777 W. Market St. The new building is to be an all-welded structure of used four-inch oil-well drill pipe and railroad rails, a combination which will provide great strength. Up-to-date equipment and modern conveniences will make the new shop one of the best in the city.

J. H. Hodgen, of Long Beach, Calif., is opening a welding shop at 2420 Cerritos Ave. in the Signal Hill oil field. The name of the shop is to be known as J. H. Hodgen Co., which will be fully equipped with up-to-date electric and acetylene welding equipment. General oil field welding, and pipe line construction will be featured in the service rendered by the new company.

The Long Beach (Calif.) Boiler Works are moving their welding and other shop equipment from their plant at 2767 Atlantic Ave. to their new quarters at 3249 Cherry Ave. The new location is situated in the north edge of the Signal Hill oil field, and the added working space and convenience of the new plant will mean much to the company and employees.

The San Diego Welding Co. recently installed a new 300-amp. Westinghouse electric welder. Mr. Frederikson, manager, reports business good in their special line of welding, which is the servicing of oil field tools and machinery repairs of all kinds.

The Harry L. Room Co., of Long Beach, Calif., which company for the past seven years has been engaged in oil-field welding and pipe-line construction work in the southern California oil fields, is closing out its business for an indefinite period. Mr. Room, manager, is leaving June 30th for Buenos Aires, Argentine Republic, on a combined business and pleasure trip. He expects to return via Galveston and the mid-continent oil fields of Texas and Oklahoma. Mr. Room is well known in the oil fields of California, having assisted in the laying of the first pipe line out of the Signal Hill oil field, and also the first line from the Santa Fe Springs field.

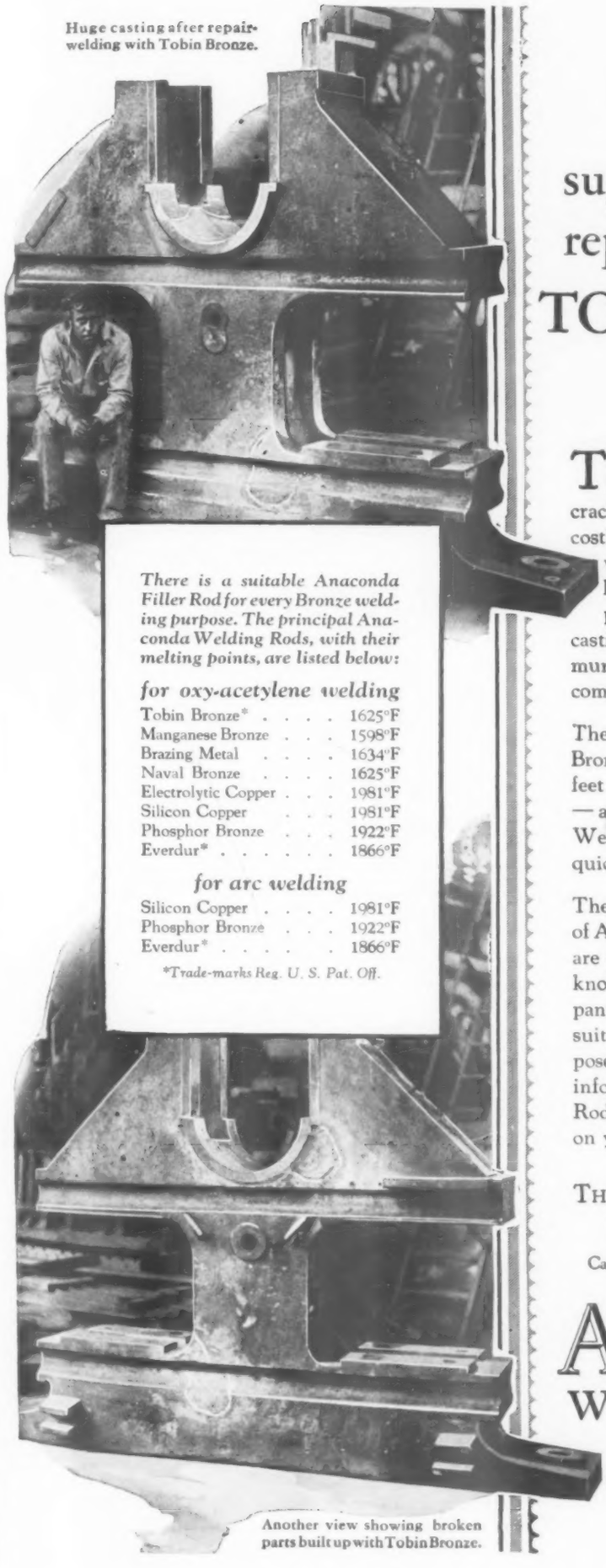
The degree of LL.D. was conferred on L. R. Smith by the University of Wisconsin, at Madison, on June 23. L. R. Smith is president of the A. O. Smith Corporation, of Milwaukee.

G. E. Harke, of the Air Reduction Sales Co., furnished the educational feature consisting of a motion picture, demonstration and lecture on oxy-acetylene welding as used on plumbing and heating installations of the present day, at a meeting of the Tri-City Plumbing and Heating Trade Development League held at Davenport, Iowa, on May 18th. The present membership of the league consists of 245 individual members and 33 firms and organizations; 105 were present at the meeting.

Jack Brandon, well-known oil-field welding-shop owner of Los Nietos, Calif., situated near the Santa Fe Springs oil field, recently sold his shops at Los Nietos and at Venice, Calif., to Smith Brothers, also of Los Nietos. The new partnership will be known as the Smith Welding Works. George (one of the brothers) is a welder of eighteen years' experience, and during the war was head welding foreman in the Los Angeles Ship Yards. Both day and night service in general oil field welding will be featured at both shops.

Fay Lindberg, of Los Nietos, Calif., who owns a number of welding shops in southern California, recently opened two new shops, one at Lompoc, Calif., and the other at Lost Hills, Calif. Both are situated in oil fields of their respective localities, and will feature general oil-field welding, 24-hr. service, with both gas and electric equipment. Chas. Camper is managing the Lompoc shop, and V. V. Waggoner is in charge of the Lost Hills branch.

The industrial heating and welding section of the industrial department of the General Electric Co., Schenectady, N. Y., has been divided into two sections. C. L. Ipsen is



Huge casting after repair-welding with Tobin Bronze.

Another view showing broken parts built up with Tobin Bronze.

There is a suitable Anaconda Filler Rod for every Bronze welding purpose. The principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze*	1625°F
Manganese Bronze	1598°F
Brazing Metal	1634°F
Naval Bronze	1625°F
Electrolytic Copper	1981°F
Silicon Copper	1981°F
Phosphor Bronze	1922°F
Everdur*	1866°F

for arc welding

Silicon Copper	1981°F
Phosphor Bronze	1922°F
Everdur*	1866°F

*Trade-marks Reg. U. S. Pat. Off.

10-ton sugar-mill casting repair-welded with TOBIN BRONZE in 18 hours

THE photographs clearly indicate how the upper and lower jaws were cracked on both sides. To prevent a costly tie-up in the mill, a prompt repair was necessary. With only local preheating, the four fractures were repaired with Tobin Bronze and the casting returned to service with a minimum loss of time. Actual welding was completed in 18 hours.

The job required 90 lbs. of ¼-inch Tobin Bronze Rod, 3 lbs. of brazing flux, 880 feet of oxygen and 880 feet of acetylene—and illustrates how Tobin Bronze Welding is used to good advantage for the quick and efficient repair of large castings.

The uniform composition and high quality of Anaconda Copper Alloy Welding Rods are due to the experience and technical knowledge of The American Brass Company in developing a wide range of alloys suitable for every bronze-welding purpose. Publication B-13 contains detailed information on all Anaconda Welding Rods. It will be mailed, free of charge, on your request.

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities
Canadian Mill: Anaconda American Brass Ltd., New Toronto, Ontario

ANACONDA WELDING RODS

ANACONDA
from mine to consumer

manager of sales of the industrial-heating section, and L. D. Meeker holds the corresponding position in the electric-welding section.

The B. F. Cowan Machine Shop, Inc., has been incorporated at Refugio, Texas, to manufacture and repair oil-field tools, and includes a welding shop. B. F. Cowan is president and general manager.

The Shockey Boiler Works, of San Diego, Calif., have recently made a very practical and unusual use of welding in the form of an all-electric-welded hoist for use in their plant. The hoist is of 3-tons capacity and is constructed of used 4-in. oil-well drill pipe. It has a 20-ft. boom and a 30-ft. mast, giving a 60-ft. circle. The engine hanger and drum hanger are both also of welded construction. Mr. Shockey recently purchased a new 300-amp. Westinghouse welder, and has also installed a new Westinghouse automatic welder mounted on a portable track.

William Stringham, assistant general superintendent of the East Works plant of the American Rolling Mill Co., of Middletown, Ohio, since 1923, has been made assistant vice-president of the company. Mr. Stringham joined the Armco organization in 1901 as a roller. With his recent promotion he assumes charge of all the rolling and finishing operations in the plant.

The Atlas Engineering Works, of Houston, Texas, specializing in the manufacture and repair of oil-field equipment, has moved into a new shop in the 5200 block on Navigation Blvd. Installed equipment includes complete electric and gas welding sets. Ernest L. Barker is manager.

The many friends of David Bartlett in Chicago and throughout the Middle West will be glad to know that after an absence of several months he again assumes the duties of Chicago manager for the Alexander Milburn Co., of Baltimore, Md. The company announces that an increased volume of stock of all equipment is to be carried in Chicago for immediate delivery to any point in the city and nearby territory.

Fred Stevenes has recently been appointed shop foreman for the Pacific Steel Building Co., of Los Angeles, Calif., designers and manufacturers of all-welded steel-structure gasoline service stations. Mr. Stevenes is well experienced in his work, having been with the company in different capacities for over five years.

The National Electric & Welding Corp., of Huntington Park, Calif., have abandoned their temporary location at 2423 E. Slauson Ave. and are now in their new home at 2777 E. Slauson Ave. Their new plant is strictly up-to-date and modern in every way, and the shop is conveniently and completely equipped for all kinds of commercial welding jobs. S. Hensley is president of the corporation.

The Southwestern Engineering Co., of Los Angeles, Calif., are constructing and installing one of their 220-type casinghead gasoline plants in the Inglewood oil field of southern California for the Pan-California Oil Corp. The plant consists of two all-welded absorption towers, 6 ft. in diameter and 40 ft. high, also two welded stills 4 ft. in diameter and 40 ft. high. All the shop work is arc welded, while the field work is practically all acetylene welded. This is the second plant recently installed for this company by the Southwestern Engineering Co.

The Pacific Iron & Steel Corp., of Los Angeles, Calif., whose plant until recently was located at 241 West 26th Ave., have moved into their new plant located at 11600 Alameda Blvd. The new plant is equipped with the latest machinery, and is well prepared with all modern conveniences to handle all kinds of work in their line. The company specializes in tanks, cranes, and structural-steel work of various descriptions, with special attention to welded construction work. John Bertone is general superintendent of the plant. Mr. Bertone was a few years ago associated with the Union Iron Works of Los Angeles.

J. R. Gauthier has recently opened a general welding repair shop at 4001 East 52nd St., in Maywood, Calif., the name of which is to be known as the Local Welding Works. Both acetylene and electric welding work of all kinds will be featured, with special attention given to cast iron work. A new U. S. L. electric welder was recently added to the equipment of the new shop. Mr. Gauthier was formerly associated with the Brainard Mfg. Co., of Los Angeles.

The Caldwell Welding & Machine Works, of Houston, Texas, has been organized by Cecil Caldwell, manager, and a shop will be opened at 1911 Franklin St., where special work will be done in arc welding. Mr. Caldwell was formerly with the Kreiter Gear & Machine Works, of Houston.

The Welded Products Corp., 17th and Cleveland Aves., Kansas City, Mo., is to build a one-story plant, to cost over $200,000 with equipment, at Independence and Topping Aves., it is reported.

Expansion of the German plant of the Moto Meter Gauge & Equipment Co., Long Island City, N. Y., is reported to be under way, and the development of the company's other European plants is under consideration. The company has secured a financial interest in F. Respassau & Co., Paris, France, licensee of Moto Meter products, who will manufacture and distribute the entire line in that country. Similar arrangements have been made with Benjamin Electric, Ltd., of London, for British manufacture and distribution.

The Paco Corporation which owns and operates a number of welding and manufacturing plants in southern California with former headquarters at Ventura, has moved its main office and plant to 1123 East 63rd St., Los Angeles. The corporation recently closed its shops at Signal Hill and at Santa Fe Springs and transferred the equipment to the Los Angeles plant. The Paco Corp. manufactures the "Paco-Berry" oil well digging bit, an expansion bit, and also mud pumps, valves, and pistons. In addition, they do oil field welding of every description. A. C. Arthur is president, and F. H. Barrett is vice-president of the corporation.

The Commercial Welding Co., of Lynnwood, Calif., recently added three new Lincoln electric welders to their plant equipment. The company specializes in the manufacture of gasoline pumps, hydraulic hoists, and miscellaneous service station equipment. The "Comwel" pump is their most recent product, on which production is just getting under way. L. L. Highfill is plant superintendent.

W. R. Fletcher was recently appointed chief engineer of the plant of The Alpaugh Engineering Co., at Torrance, Calif. Mr. Fletcher was formerly in the Air Service of the U. S. Army. The company is just completing a contract with the Government for a large number of airplane landing skis for service in the snow country. These skis are of all-welded construction, and are surfaced with heat-treated duralumin.